MUKONDELELI WIND ENERGY FACILITY (RF) (PTY) LTD

PROPOSED MUKONDELELI WIND ENERGY FACILITY UP TO 132 KV GRID CONNECTION NEAR SECUNDA, MPUMALANGA (REFERENCE: 1/3/1/16/1G-276)

FINAL BASIC ASSESSMENT REPORT

09 March 2023

FINAL

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SIGNATURES

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This Final Basic Assessment Report (report) for the proposed Mukondeleli Wind Energy Facility 132 kV up to 132 kV Grid Connection Transmission Line has been prepared by WSP Group Africa Proprietary Limited (WSP) on behalf and at the request of Mukondeleli Wind Energy Facility (RF) Proprietary Limited (Client), as part of the application process for Environmental Authorisation.

Unless otherwise agreed by us in writing, we do not accept responsibility or legal liability to any person other than the Client for the contents of, or any omissions from, this Report.

To prepare this Report, we have reviewed only the documents and information provided to us by the Client or any third parties directed to provide information and documents to us by the Client. We have not reviewed any other documents in relation to this Report, except where otherwise indicated in the Report.

DOCUMENT DESCRIPTION

CLIENT

Mukondeleli Wind Energy Facility (RF) (Pty) Ltd

PROJECT NAME

Mukondeleli Wind Energy Facility 132 kV up to 132 kV Grid Connection, Secunda, Mpumalanga

REPORT TYPE

Final Basic Assessment Report

MDARDLEA REFERENCE NUMBER

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PRODUCTION TEAM

APPLICANT

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WSP

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Principal Associate	Anri Scheepers
Desktop Geotechnical Assessment	Heather Davis

SPECIALIST

Heritage and Palaeontology Specialist	Jayson Orton (ASHA Consulting (Pty) Ltd)
Agriculture Specialist	Johan Lanz
Ecology Specialist	Dr Noel van Rooyen and Prof. Gretel van Rooyen (Ekotrust CC)
Aquatic Specialist	Rudi Bezuidenhout (Iggdrasil Scientific Services & Limosella Consulting)
Avifauna Specialist	Chris van Rooyen (Chris van Rooyen Consulting)
Social Specialist	Tony Barbour (Tony Barbour Environmental Consulting)
Visual Specialist	Kerry Schwartz (SLR Consulting)
Risk Assessment	Debra Mitchell (iSHEcon)

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1 INTRODUCTION

1.1 BACKGROUND AND TERMS OF REFERENCE

Mukondeleli Wind Energy Facility (RF) (Pty) Ltd (the Developer) is proposing the development Mukondeleli Wind Energy Facility (WEF) in an area of approximately 3 650ha, with a maximum export capacity of up to 300MW and a, up to 132 kV Grid Connection. The proposed project will be operated under a Special Purpose Vehicle (SPV). **This report is specific to the 132kV Grid Connection**.

In order for the proposed project to proceed, it will require an Environmental Authorisation (EA) from the Competent Authority (CA) (i.e. the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA)).

1.2 PURPOSE OF THIS REPORT

This report documents the process and findings of the Basic Assessment (BA) process for the proposed Mukondeleli WEF up to 132kV Grid Connection (hereafter referred to as the "Project"), located approximately 8km south of Secunda in the Gert Sibande District Municipality and the Govan Mbeki Local Municipality, near the town of Secunda, in the Mpumalanga Province of South Africa.

The BA process is an interdisciplinary procedure to ensure that environmental and social considerations are included in decisions regarding projects. Simply defined, the process aims to identify the possible environmental and social effects of a proposed activity and how those impacts can be mitigated. In the context of this report, the purpose of the BA process is to inform decision-makers and the public of potential negative and positive consequences of the proposed construction of Mukondeleli WEF up to 132 kV Grid Connection Transmission Line. This provides the competent authority (CA) sufficient information to make an informed decision with regards to granting or refusing the EA applied for.

1.3 DETAILS OF KEY ROLE PLAYERS

1.3.1 PROJECT PROPONENT

Mukondeleli Wind Energy Facility RF (Pty) Ltd is the project proponent (Applicant) with regards to this application for the construction and operation of the WEF and associated infrastructure. **Table 1-1** provides the relevant details of the project proponent.

Table 1-1: Details of Project Proponent

PROPONENT:	MUKONDELELI WIND ENERGY FACILITY (RF) (PTY) LTD
Contact Person:	Mercia Grimbeek / Kyle Swartz
Postal Address	Suite 104, Albion Springs, 183 Main Road, Rondebosch, Cape Town, South Africa 7700
Telephone:	+27 21 207 2181
Email:	Mercia.Grimbeek@enertrag.com / kyle.swartz@enertrag.com

1.3.2 COMPETENT AUTHORITY

Section 24C(2)(a) of the National Environmental Management Act 107 of 1998 (NEMA) stipulates that the Minister of Forestry, Fisheries and the Environment ("the Minister") must be identified as the CA if the activity has implications for international environmental commitments or relations. GN 779 of 01 July 2016 identifies the Minister as the CA for the consideration and processing of environmental authorisations and amendments thereto for activities related to the Integrated Resource Plan (IRP) 2010 – 2030.

However, due to the fact that the power generated by the Mukondeleli WEF will be made available to a private off-taker, the project is not related to the IRP, and therefore, the CA was confirmed to be the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA).

The CA (i.e. MDARDLEA) was confirmed during the Pre-Application Meeting held on **14 July 2022**.

Table 1-2 provides the relevant details of the competent authority on the Project.

Table 1-2: Competent Authority

ASPECT	COMPETENT / COMMENTING AUTHORITY	CONTACT DETAILS
Competent Authority: Environmental Authorisation	Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA	Case Officer: Okwethu Fakude Email: oqfakude@mpg.gov.za

1.3.3 COMMENTING AUTHORITIES

The following commenting authorities have been identified for this application:

- Department of Mineral Resources and Energy (DMRE);
- Department of Forestry, Fisheries and Environment (DFFE): Biodiversity and Conservation;
- DFFE: Protected Areas;
- Department of Water and Sanitation (DWS);
- Vaal Water Management Area (WMA) Authority;
- South African Heritage Resource Agency (SAHRA);
- Mpumalanga Heritage Resources Authority (MHRA);
- Mpumalanga Tourism and Parks Agency (MTPA);
- Civil Aviation Authority (CAA);
- Air Traffic and Navigation Services (ATNS);
- Department of Defence (SA Army) (DD);
- Astronomy Management Authority (AMA);
- South African Weather Services (SAWS);
- South African National Roads Agency Limited (SANRAL);
- Gert Sibande District Municipality; and
- Govan Mbeki Municipality (GMM) Local Municipality.

1.3.4 ENVIRONMENTAL ASSESSMENT PRACTITIONER

WSP Group Africa (Pty) Ltd (WSP) has been appointed in the role of Independent Environmental Assessment Practitioner (EAP) to undertake the S&EIR processes for the development of the Project. The CV of the EAP is available in **Appendix A**. The EAP declaration of interest and undertaking is included in **Appendix B**. **Table 1-3** details the relevant contact details of the EAP. In order to adequately identify and assess potential environmental impacts, a number of specialists will support the EAP.

Table 1-3: Details of the Environmental Assessment Practitioner

ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP)	WSP GROUP AFRICA (PTY) LTD
Contact Person:	Ashlea Strong
Postal Address:	Building C, Knightsbridge, 33 Sloane Street, Bryanston, 2191, South Africa
Telephone:	011 361 1392
Fax:	011 361 1381
E-mail:	Ashlea.Strong@wsp.com
Professional Registration:	EAPASA (2019/1005)
Qualifications:	— Masters in Environmental Management, University of the Free State — B Tech, Nature Conservation, Technikon SA — National Diploma in Nature Conservation, Technikon SA

STATEMENT OF INDEPENDENCE

Neither WSP nor any of the authors of this Report have any material present or contingent interest in the outcome of this Report, nor do they have any business, financial, personal or other interest that could be reasonably regarded as being capable of affecting their independence. WSP has no beneficial interest in the outcome of the assessment.

1.4 SPECIALIST

Specialist input was required in support of this application for EA. The details of the specialists are provided in **Table 1-4** below. The specialist declarations are included in **Appendix C**.

Table 1-4: Details of Specialists

ASSESSMENT	NAME OF SPECIALIST	COMPANY	SECTIONS IN REPORT
Agriculture	Johann Lanz	Independent consultant	Section 6.1.5 Section 7.3 **Appendix F-8**
Avifauna	Chris van Rooyen	Chris van Rooyen Consulting	Section 6.2.7 Section 6.10 **Appendix F-1**

ASSESSMENT	NAME OF SPECIALIST	COMPANY	SECTIONS IN REPORT
Terrestrial Ecology (including Plant and Animal Species Themes)	Dr Noel van Rooyen and Prof. Gretel van Rooyen	Ekotrust CC	Section 6.2.1 – 6.2.6 Section 7.7 **Appendix F-2**
Aquatic	Rudi Bezuidenhout	Iggdrasil Scientific Services & Limosella Consulting	Section 6.1.6 Section 7.6 **Appendix F-6**
Heritage and Palaeontology	Jayson Orton	ASHA Consulting (Pty) Ltd	Section 6.3.2 Section 7.10 and 7.11 **Appendix F-3 and F-4**
Socio-economic	Tony Barbour	Tony Barbour Environmental Consulting	Section 6.3.4 Section 7.12 **Appendix F-5**
Visual	Kerry Schwartz	SiVEST SA (Pty) Ltd / SLR Consulting	Section 6.3.3 Section 7.9 **Appendix F-7**
Geotechnical	Heather Davis	WSP Group Africa (Pty) Ltd	Section 6.1.3 **Appendix F-10**
Risk	Debra Mitchell	iSHEcon	Section 7.13 **Appendix F-9**

1.5 BASIC ASSESSMENT TERMS OF REFERENCE

The 2014 Environmental Impact Assessment (EIA) Regulations (GNR 982), as amended, identifies the proposed Mukondeleli WEF up to 132 kV Grid Connection development as an activity being subject to a Basic Assessment process due to the applicability of the EIA Listing Notices 1 (GNR 983, as amended) and Listing Notice 3 (GNR 985, as amended).

As defined in Appendix 2 of GNR 982, as amended, the objective of the BA process is to, through a consultative process:

— Identify the relevant policies and legislation relevant to the activity;
— Motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
— Identify and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking process;
— Identify and confirm the preferred site, through a detailed site selection process, which includes an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;
— Identify the key issues to be addressed in the assessment phase;

- Agree on the level of assessment to be undertaken, including the methodology to be applied, the expertise required as well as the extent of further consultation to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration, and probability of the impacts to inform the location of the development footprint within the preferred site; and
- Identify suitable measures to avoid, manage or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

Public participation is a requirement of Basic Assessment ; it consists of a series of inclusive interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the decision-making process. Effective public participation requires the prior disclosure of relevant and adequate project information to enable stakeholders to understand the risks, impacts, and opportunities of the Proposed Project. The objectives of the public participation process can be summarised as follows:

- Identify relevant individuals, organisations and communities who may be interested in or affected by the Proposed Project;
- Clearly outline the scope of the proposed Project, including the scale and nature of the existing and proposed activities;
- Identify viable proposed Project alternatives that will assist the relevant authorities in making an informed decision;
- Identify shortcomings and gaps in existing information;
- Identify key concerns, raised by Stakeholders that should be addressed in the subsequent specialist studies;
- Highlight the potential for environmental impacts, whether positive or negative; and
- To inform and provide the public with information and an understanding of the Proposed Project, issues and solutions.

1.6 BASIC ASSESSMENT REPORT STRUCTURE

The structure of the final BAR (this report) is presented in **Table 1-5**.

Table 1-5: Structure of this report

SECTION	CONTENTS
1 – Introduction	Provides a brief background and outlines the purpose of this document, as well as identifying the key role players, content of the report and the assumptions and limitations applicable to the assessment.
2 – Governance Framework	Provides a brief summary and interpretation of the relevant legislation in terms of the proposed project.
3 – Basic Assessment Process	Provides a description of the BA process being undertaken and the methodology employed.
4 – Project Description	Describes the project location and surrounding area, project history, and a project description.
5 – Project Alternatives	Provides a summary description of the proposed project alternatives.

SECTION	CONTENTS
6 – Baseline Environment	Describes the biophysical and socio-economic characteristics of the affected environment against which potential project impacts are assessed.
7 – Environmental Impact Assessment	Describes the specialist studies undertaken and assesses the potential impacts of the project as well as project alternatives. The significance of the impacts and proposed mitigation measures are presented.
8 – Cumulative Impact Assessment	Describes the cumulative impacts identified by the EAP and Specialists and assesses the cumulative impacts. The significance of the impacts and proposed mitigation measures are presented.
9 – Environmental Impact Statement	Provides the Environmental Impacts Statement including principal findings as well as recommendations and the authorisation opinion.
10 –Way Forward	Outlines the stakeholder engagement details associated with the public review period.

2 GOVERNANCE FRAMEWORK

2.1 NATIONAL ENVIRONMENTAL LEGAL FRAMEWORK

The South African regulatory framework establishes well-defined requirements and standards for environmental and social management of industrial and civil infrastructure developments. Different authorities at both national and regional levels carry out environmental protection functions. The applicable legislation and policies are shown in **Table 2-1**.

Table 2-1: Applicable National Legislation[1]

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
The Constitution of South Africa (No. 108 of 1996)	The Constitution cannot manage environmental resources as a stand-alone piece of legislation hence additional legislation has been promulgated to manage the various spheres of both the social and natural environment. Each promulgated Act and associated Regulations are designed to focus on various industries or components of the environment to ensure that the objectives of the Constitution are effectively implemented and upheld in an on-going basis throughout the country. In terms of Section 7, a positive obligation is placed on the State to give effect to the environmental rights.
National Environmental Management Act (No. 107 of 1998)	In terms of Section 24(2) of the NEMA, the Minister may identify activities, which may not commence without prior authorisation. The Minister thus published GNR 983 (as amended) (Listing Notice 1), GNR 984 (as amended) (Listing Notice 2) and GNR 985 (as amended) (Listing Notice 3) listing activities that may not commence prior to authorisation. The regulations outlining the procedures required for authorisation are published in the EIA Regulations of 2014 (GNR 982) (as amended). Listing Notice 1 identifies activities that require a BA process to be undertaken, in terms of the EIA Regulations, prior to commencement of that activity. Listing Notice 2 identifies activities that require an S&EIR process to be undertaken, in terms of the EIA Regulations, prior to commencement of that activity. Listing Notice 3 identifies activities within specific areas that require a BA process to be undertaken, in terms of the EIA Regulations, prior to commencement of that activity. WSP undertook a legal review of the listed activities according to the proposed project description to conclude that the activities listed in in this section are considered applicable to the transmission line. A BA process must be followed. An EA is required and will be applied for with the MDARDLEA.
Listing Notice 1: GNR 983, as amended	***Activity 11(i):*** *The development of facilities or infrastructure for the transmission and distribution of electricity—* *(i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or* *excluding the development of bypass infrastructure for the transmission and distribution of electricity where such bypass infrastructure is —* *(a) temporarily required to allow for maintenance of existing infrastructure;* *(b) 2 kilometres or shorter in length;*

[1] It should be noted that all dimensions outlined in relation to Listing Notice 1, 2 and 3 are provisional and are subject to final design.

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	(c) within an existing transmission line servitude; and *(d) will be removed within 18 months of the commencement of development.* **Applicability:** The 132 kV overhead powerline (OHPL) will connect the Mukondeleli WEF to a substation located within the Sasol Secunda Primary Area. As illustrated in **Figure** 2-1 and **Figure 2-2** the entire transmission line (including substations), is located **inside the urban edge.** **This activity is therefore <u>Not Applicable</u> to this application**.
Listing Notice 1: GNR 983, as amended	***Activity 12 (ii), (a) and (c):*** *The development of—* *(ii) infrastructure or structures with a physical footprint of 100 square metres or more;* *where such development occurs—* *(a) within a watercourse; or* *(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse* **Applicability:** The OHPL will require the erection of tower structures, which may require a construction area of approximately 100m^2. There is the potential that a tower structure or access road will transverse a watercourse (or drainage line) and maybe constructed within 32 m of these watercourses. This activity will potentially be triggered by the proposed construction of the transmission infrastructure and access road.
Listing Notice 1: GNR 983, as amended	***Activity 14*** *The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres.* **Applicability:** A BESS is proposed to be developed at the Sasol Substation. In the event that Redox Flow Battery technology is considered preferred, storage and handling of dangerous goods will be required. It is anticipated that the storage capacity will be greater than 80m^3 but not exceeding 500m^3.
Listing Notice 1: GNR 983, as amended	***Activity 19:*** *The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.* **Applicability:** The OHPL will require the erection of tower structures and an access road. There is the potential that a tower structure or access road will transverse a watercourse (or drainage line) which will

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	require excavation or removal of soil or sand from the watercourse. This activity will potentially be triggered by the proposed construction of the transmission infrastructure and access road..
Listing Notice 1: GNR 983, as amended	***Activity 27:*** *The clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for-* *(i) the undertaking of a linear activity; or* *(ii) maintenance purposes undertaken in accordance with a maintenance management plan.* **Applicability:** The OHPL are considered a linear activity and therefore this activity is not triggered by the proposed construction of the transmission lines. However, the construction of the common 132 kV substation will require the clearance of indigenous vegetation of more than 1ha but less than 20 ha.
Listing Notice 3: GNR 985, as amended	***Activity 4(f)(ii)(aa)(bb) –*** *The development of a road wider than 4 metres with a reserve less than 13,5 metres.* *f. Mpumalanga* *ii. Inside urban areas:* *(aa) Areas zoned for use as public open space; or* *(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.;* **Applicability:** An access road will be required along the length of the OHPL alignment where it is not adjacent to existing roads. The access road is typically a two track gravel road that will potentially be wider than 4m. The alignment of the transmission line is located within, within Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA). As illustrated in **Figure** 2-1 and **Figure 2-2** the entire OHPL (including substations), is located **inside the urban edge**. However, portions of the area are zoned as a major open space system. This activity is therefore triggered by the proposed construction of the transmission infrastructure and the access road.
Listing Notice 3: GNR 985, as amended	***Activity 12(f)(ii)*** *The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.* *f. Mpumalanga* *ii. Within critical biodiversity areas identified in bioregional plans; or* **Applicability:**

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	The route for the proposed OHPL traverses CBAs. The OHPL will require the erection of tower structures, an access road, and a common 132 kV on-site substation which will cumulatively require the clearance of indigenous vegetation of more than 300m^2.This activity is therefore triggered by the proposed construction of the transmission infrastructure and the access road..
Listing Notice 3: GNR 985, as amended	***Activity 14(ii)(a)(c)(f)****(ii)(aa)(bb)* *The development of—* *(ii) infrastructure or structures with a Physical footprint of 10 Square metres or more;* *where such development occurs—* *(a) within a watercourse;* *(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse;* *f. Mpumalanga* *ii. Inside urban areas:* *(aa) Areas zoned for use as public open space; or* *(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.;* **Applicability:** The physical footprint of the transmission infrastructure will be within 32 m of the outer extent of the delineated watercourses on site located within CBA and ESA. As illustrated in **Figure** 2-1 and **Figure 2-2** the entire OHPL (including substations), is located **inside the urban edge**. However, portions of the area are zoned as a major open space system. This activity is therefore triggered by the proposed construction of the transmission infrastructure and the access road.
Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes (GNR 320, 20 March 2020 and GNR 1150, 30 October 2020)	The protocols provide the criteria for specialist assessment and minimum report content requirements for impacts for various environmental themes for activities requiring environmental authorisation. The protocols replace the requirements of Appendix 6 of the EIA Regulations, 2014, as amended. The assessment and reporting requirements of the protocols are associated with a level of environmental sensitivity identified by the national web based environmental screening tool (screening tool). The following environmental themes were applicable to the Mukondeleli 132kV Grid Connection project: — Agricultural Theme — Animal Species Theme — Aquatic Biodiversity Theme — Archaeological and Cultural Heritage Theme — Civil Aviation Theme — Defence Theme — Palaeontology Theme — Plant Species Theme

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	— Terrestrial Biodiversity Theme
National Environmental Management: Waste Act (59 of 2008) (NEM:WA)	This Act provides for regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation. The Act also provides for the licensing and control of waste management activities through GNR. 921 (2013), as amended: List of Waste Management Activities that Have, or are Likely to Have, a Detrimental Effect on the Environment. The proposed project does not constitute a Listed Activity requiring a Waste Management Licence (WML) as defined in GNR 921, as amended. However, the contents of this Environmental Management Programme (EMPr) will include reasonable measures for the prevention of pollution and good international industry practice (GIIP).
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)	The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) was promulgated in June 2004 within the framework of NEMA to provide for the management and conservation of national biodiversity. The NEMBA's primary aims are for the protection of species and ecosystems that warrant national protection, the sustainable use of indigenous biological resources, the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources. In addition, the NEMBA provides for the establishment and functions of a South African National Biodiversity Institute (SANBI). SANBI was established by the NEMBA with the primary purpose of reporting on the status of the country's biodiversity and conservation status of all listed threatened or protected species and ecosystems. During screening CBAs were identified, which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to meet national biodiversity objectives. Based on the screening, a significant part of the Project Area falls within CBA (Irreplaceable and Optimal), especially the especially the western part of the site. There are also some Ecological Support Area (ESA) Local and Landscape corridors demarcated along the Mukondeleli132kV OHPL corridor and substations. According to the description for the Mpumalanga Biodiversity Sector Plan (MBSP) Terrestrial Assessment categories, CBAs are areas that are required to meet biodiversity targets (for biodiversity pattern and ecological process features). The management approach is that they should remain in a natural state. CBAs are areas of high biodiversity value which are usually at risk of being lost and usually identified as important in meeting biodiversity targets, except for Critically Endangered Ecosystems or Critical Linkages. CBAs in the Province can be divided into two sub-categories: — Irreplaceable (parts of the site are within this sub-category), and — Optimal (northern parts of the site are within this sub-category). The site is located in the Soweto Highveld Grassland vegetation type (Mucina & Rutherford 2006, SANBI 2006-2018) which is classified as "Vulnerable" (NEMA 2011, Skowno et al. 2018). Terrestrial ecology studies have been undertaken (**Appendix F-2**) to inform the assessment of impacts and will include flora surveys of the project footprint to determine the presence of flora species of concern (SoC), and bird surveys of the area to define the potential risks to bird SoC. The Conservation of Agricultural Resources Act (No. 43 of 1983) (CARA) Regulations with regards to alien and invasive species have been superseded by the National Environmental Management: Biodiversity Act, 2004 (Act no. 10 of 2004) – Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014. Specific management measures for the control

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	of alien and invasive plants will be included in the Environmental Management Programme (EMPr).
National Environmental Management Protected Areas Act (No. 57 of 2003)	The purpose of the National Environmental Management Protected Areas Act (No. 57 of 2003) (NEMPAA) is to, inter alia, provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. To this end, it provides for the declaration and management of various types of protected areas. According to the National Protected Area Expansion Strategy (NPAES), there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore outside the NPAES focus area. In addition, the site is also not earmarked in the 5-year plan of the Mpumalanga PAES (data supplied by M. Lötter, MTPA).
The National Water Act (No. 36 Of 1998)	The National Water Act, 1998 (Act No. 36 of 1998) (NWA) provides the framework to protect water resources against over exploitation and to ensure that there is water for social and economic development, human needs and to meet the needs of the aquatic environment. The Act defines water source to include watercourses, surface water, estuary or aquifer. A watercourse is defined in the Act as a river or spring, a natural channel in which water flows regularly or intermittently, a wetland, lake or dam into which or from which water flows, and any collection of water that the Minister may declare a watercourse. Section 21 of the Act outlines a number of categories that require a water user to apply for a Water Use License (WUL) and Section 22 requires water users to apply for a General Authorisation (GA) with the Department of Water and Sanitation (DWS) if they are under certain thresholds or meet certain criteria. The list of water uses applicable to the proposed Project include: *a) Taking water from a water resource;* *c) Impeding or diverting the flow of water in a watercourse;* *g) Disposing of waste in a manner which may detrimentally impact on a water resource;* *i) Altering the bed, banks, course or characteristics of a watercourse;* The DWS will make the final decision on water uses that are applicable to the project through a pre-application meeting after which a Water Use Authorisation Application (WUA) as determined by the risk assessment will be undertaken in compliance with procedural regulations published by the DWS within General Notice 267 (GN267). These regulations specify required information per water use and the reporting structure of required supporting technical information.
The National Heritage Resources Act (No. 25 Of 1999)	The National Heritage Resource Act (Act No. 25 of 1999) (NHRA) serves to protect national and provincial heritage resources across South Africa. The NHRA provides for the protection of all archaeological and palaeontological sites, the conservation and care of cemeteries and graves by the South African Heritage Resources Agency (SAHRA), and lists activities that require any person who intends to undertake to notify the responsible heritage resources agency and furnish details regarding the location, nature, and extent of the proposed development. Part 2 of the NHRA details specific activities that require a Heritage Impact Assessment (HIA) that will need to be approved by SAHRA. Parts of Section 35, 36 and 38 apply to the proposed project, principally: — Section 35 (4) - No person may, without a permit issued by the responsible heritage resources authority- — destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	— destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite. — Section 38 (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as- — any development or other activity which will change the character of a site— (i) exceeding 5 000 m^2 in extent, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development. In terms of Section 38(8), approval from the heritage authority is not required if an evaluation of the impact of such development on heritage resources is required in terms of any other legislation (such as NEMA), provided that the consenting authority ensures that the evaluation of impacts fulfils the requirements of the relevant heritage resources authority in terms of Section 38(3) and any comments and recommendations of the relevant resources authority with regard to such development have been taken into account prior to the granting of the consent. However, should heritage resources of significance be affected by the proposed Mukondeleli 132kV Grid connection, a permit is required to be obtained prior to disturbing or destroying such resources as per the requirements of Section 48 of the NHRA, and the SAHRA Permit Regulations (GN R668). A desktop Heritage Scoping Report (**Appendix 3**) has been carried out by a suitably qualified specialist, revealing four finds (three stone features and one possible grave). The proposed project will be loaded onto the SAHRIS portal for comment by SAHRA.
Mineral and Petroleum Resources Development Act (No. 28 of 2002)	The aim of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) is to make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources. Section 53(1) of the MPRDA provides that any person who intends to use the surface of any land in any way that may be contrary to any object of the MPRDA, or which is likely to impede any such object, must apply to the Minister of Mineral Resources (the Minister) for approval. Section 53 of the MPRDA provides a mechanism for ensuring that, inter alia, the mining of mineral resources is not detrimentally affected through the use of the surface of land and which may, for example, result in the sterilisation of a mineral resource. A Section 53 approval will be required due to the fact that the project is located on various mining right areas. The Amendment Regulations (GNR 420 of 27 March 2020) introduced a template for section 53 applications (Form Z) and the specific information that applicants will need to provide as part of a section 53 application.
Noise Control Regulations in terms of the Environmental Conservation, 1989 (Act 73 of 1989)	In South Africa, environmental noise control has been in place for three decades, beginning in the 1980s with codes of practice issued by the South African National Standards (formerly the South African Bureau of Standards, SABS) to address noise pollution in various sectors of the country. Under the previous generation of environmental legislation, specifically the Environmental Conservation Act 73 of 1989 (ECA), provisions were made to control noise from a National level in the form of the Noise Control Regulations (GNR 154 of January 1992). In later years, the ECA was replaced by the NEMA as amended. The National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA) was published in line with NEMA and contains noise control provisions under Section 34: *(1) The minister may prescribe essential national standards –* *(a) for the control of noise, either in general or by specific machinery or activities or in specified places or areas; or*

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	(b) for determining – *(i) a definition of noise; and* *(ii) the maximum levels of noise.* *(2) When controlling noise, the provincial and local spheres of government are bound by any prescribed national standards.* Under NEMAQA, the Noise Control Regulations were updated and are to be applied to all provinces in South Africa. The Noise Control Regulations give all the responsibilities of enforcement to the Local Provincial Authority, where location specific by-laws can be created and applied to the locations with approval of Provincial Government. Where province-specific regulations have not been promulgated, acoustic impact assessments must follow the Noise Control Regulations. Furthermore, NEMAQA prescribes that the Minister must publish maximum allowable noise levels for different districts and national noise standards. These have not yet been accomplished and as a result all monitoring and assessments are done in accordance with the South African National Standards (SANS) 10103:2008 and 10328:2008.
Conservation of Agricultural Resources Act (No. 43 of 1983)	The Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA) provides for the implementation of control measures for soil conservation works as well as alien and invasive plant species in and outside of urban areas. In terms of the amendments to the regulations under the CARA, landowners are legally responsible for the control of alien species on their properties. Various Acts administered by the DFFE and the DWS, as well as other laws (including local by-laws), spell out the fines, terms of imprisonment and other penalties for contravening the law. Although no fines have yet been placed against landowners who do not remove invasive species, the authorities may clear their land of invasive alien plants and other alien species entirely at the landowners' cost and risk. The CARA Regulations with regards to alien and invasive species have been superseded by NEMBA Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014.
Civil Aviation Act (No. 13 of 2009)	Civil aviation in South Africa is governed by the Civil Aviation Act (Act 13 of 2009). This Act provides for the establishment of a stand-alone authority mandated with controlling, promoting, regulating, supporting, developing, enforcing and continuously improving levels of safety and security throughout the civil aviation industry. This mandate is fulfilled by South African Civil Aviation Authority (SACAA) as an agency of the Department of Transport (DoT). SACAA achieves the objectives set out in the Act by complying with the Standards and Recommended Practices (SARPs) of the International Civil Aviation Organisation (ICAO), while considering the local context when issuing the South African Civil Aviation Regulations (SA CARs). As of the 1st of May 2021, Air Traffic and Navigation Services (ATNS) has been appointed as the new Obstacle application Service Provider for Windfarms and later Solar Plants. Their responsibility would pertain to the assessments, maintenance, and all other related matters in respect to Windfarms and in due time Power Plant assessments. The DEA Screening Tool Report identified Civil Aviation as having high sensitivity for the proposed Mukondeleli 132kV Grid Connection, and as being located between 8 and 15km of other civil aviation arerodrome. An Application for the Approval of Obstacles will also be submitted to ATNS. SACAA will be included on the project stakeholder database. They will be informed of the proposed Project, and comment will be sought from these authorities as applicable.

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
Occupational Health and Safety Act (No. 85 of 1993)	The National Occupational Health and Safety Act (No. 85 of 1993) (OHSA) and the relevant regulations under the Act are applicable to the proposed project. This includes the Construction Regulations promulgated in 2014 under Section 43 of the Act. Adherence to South Africa's OHSA and its relevant Regulations is essential.
National Energy Act (No. 34 of 2008)	The National Energy Act aims to ensure that diverse energy resources are available, in sustainable quantitates, and at affordable prices, to the South African economy in support of economic growth and poverty alleviation, taking into account environmental management requirements and interactions amongst economic sectors. The main objectives of the Act are to: — Ensure uninterrupted supply of energy to the Republic; — Promote diversity of supply of energy and its sources; — Facilitate effective management of energy demand and its conservation; — Promote energy research; — Promote appropriate standards and specifications for the equipment, systems and processes used for producing, supplying and consuming energy; — Ensure collection of data and information relating to energy supply, transportation and demand; — Provide for optimal supply, transformation, transportation, storage and demand of energy that are planned, organised and implemented in accordance with a balanced consideration of security of supply, economics, consumer protection and a sustainable development; — Provide for certain safety, health and environment matters that pertain to energy; — Facilitate energy access for improvement of the quality of life of the people of Republic; — Commercialise energy-related technologies; — Ensure effective planning for energy supply, transportation, and consumption; and — Contribute to sustainable development of South Africa's economy. In terms of the act, the Minister of Energy is mandated to develop and, on an annual basis, review and publish the Integrated Energy Plan (IEP) in the Government Gazette. The IEP analyses current energy consumption trends within different sectors of the economy (i.e. agriculture, commerce, industry, residential and transport) and uses this to project future energy requirements, based on different scenarios. The IEP and the Integrated Resource Plan are intended to be updated periodically to remain relevant. The framework is intended to create a balance between energy demand and resource availability so as to provide low-cost electricity for social and economic development, while taking into account health, safety and environmental parameters.
Electricity Regulation Act (No. 4 of 2006)	The Electricity Regulation Act (No. 4 of 2006) (ERA) aims to: — Achieve the efficient, effective, sustainable and orderly development and operation of electricity supply infrastructure in South Africa; — Ensure that the interests and needs of present and future electricity customers and end users are safeguarded and met, having regard to the governance, efficiency. effectiveness and long-term sustainability of the electricity supply industry within the broader context of economic energy regulation in the Republic: — Facilitate investment in the electricity supply industry; — Facilitate universal access to electricity; — Promote the use of diverse energy sources and energy efficiency; — Promote competitiveness and customer and end user choice; and

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	— Facilitate a fair balance between the interests of customers and end users, licensees, investors in the electricity supply industry and the public. The Act establishes a National Energy Regulator as the custodian and enforcer of the National Electricity Regulatory Framework. The Act also provides for licenses and registration as the manner in which generation, transmission, distribution, trading and the import and export of electricity are regulated.

2.2 POLICES AND PLANS

Table 2-2 Summarised key policies and plans as an outline of the governance framework for the project.

Table 2-2: Applicable Regional Policies and Plans

APPLICABLE POLICY	DESCRIPTION OF POLICY
National Development Plan	The National Development Plan aims to eliminate poverty and reduce inequality by 2030. The NDP identifies a number of enabling milestones. Of relevance to the proposed development the NDP refers to the need to produce sufficient energy to support industry at competitive prices and ensure access for poor households, while reducing carbon emissions per unit of power by about one-third. In this regard the infrastructure is not just essential for faster economic growth and higher employment. It also promotes inclusive growth, providing citizens with the means to improve their own lives and boost their incomes. Infrastructure is essential to development. Chapter 3, Economy and Employment, identifies some of the structural challenges specific to South Africa, including an energy constraint that will act as a cap on growth and on options for industrialisation. The NDP notes that from an environmental perspective South Africa faces several related challenges. The reduction of greenhouse gas emissions and shift to a green low-carbon economy, is one of these challenges. In terms of implementation the NDP identifies three phases. The first two are of specific relevance to the proposed project. The first phase (2012–2017) notes that ensuring the supply of energy and water is reliable and sufficient for a growing economy. The second phase (2018–2023) involves building on the first phase to lay the foundations for more intensive improvements in productivity. The provision of affordable and reliable energy is a key requirement for this to take place. Chapter 4, Economic infrastructure, notes that economic infrastructure provides the foundation for social and economic development. In this regard South Africa must invest in a strong network of economic infrastructure designed to support the country's medium- and long-term economic and social objectives. The plan envisages that, by 2030, South Africa will have an energy sector that promotes: — Economic growth and development through adequate investment in energy infrastructure. The sector should provide reliable and efficient energy service at competitive rates, while supporting economic growth through job creation. — Environmental sustainability through efforts to reduce pollution and mitigate the effects of climate change. More specifically, South Africa should have adequate supply security in electricity and in liquid fuels, such that economic activity, transport, and welfare are not disrupted. The plan sets out steps that aim to ensure that, in 20 years, South Africa's energy system looks very different to the current situation. In this regard coal will contribute

APPLICABLE POLICY	DESCRIPTION OF POLICY
	proportionately less to primary-energy needs, while gas and renewable energy resources, will play a much larger role.
Integrated Resource Plan 2010 – 2030	The IRP is an electricity capacity plan which aims to provide an indication of the country's electricity demand, how this demand will be supplied and what it will cost. On 6 May 2011, the then Department of Energy (DoE) released the Integrated Resource Plan 2010-2030 (IRP 2010) in respect of South Africa's forecast energy demand for the 20-year period from 2010 to 2030. The promulgated IRP 2010–2030 identified the preferred generation technology required to meet expected demand growth up to 2030. It incorporated government objectives such as affordable electricity, reduced greenhouse gas (GHG) emissions, reduced water consumption, diversified electricity generation sources, localisation and regional development. The IRP recognises that Solar photovoltaic (PV), wind and concentrated solar power (CSP) with storage present an opportunity to diversify the electricity mix, to produce distributed generation and to provide off-grid electricity. Renewable technologies also present huge potential for the creation of new industries, job creation and localisation across the value chain.
New Growth Path	Government released the New Economic Growth Path Framework on 23 November 2010. The aim of the framework is to enhance growth, employment creation and equity. The policy's principal target is to create five million jobs over the next 10 years and reflects government's commitment to prioritising employment creation in all economic policies. The framework identifies strategies that will enable South Africa to grow in a more equitable and inclusive manner while attaining South Africa's developmental agenda. Central to the New Growth Path is a massive investment in infrastructure as a critical driver of jobs across the economy. In this regard the framework identifies investments in five key areas namely: energy, transport, communication, water, and housing.
National Infrastructure Plan	The South African Government adopted a National Infrastructure Plan (NIP) in 2012. The NIP aims to transform the South African economic landscape while simultaneously creating significant numbers of new jobs and strengthening the delivery of basic services. It outlines the challenges and enablers which needs to be addressed in the building and developing of infrastructure. The Presidential Infrastructure Coordinating Commission (PICC) was established by the Cabinet to integrate and coordinate the long-term infrastructure build. The plan also supports the integration of African economies. In terms of the plan Government will invest R827 billion over the next three years to build new and upgrade existing infrastructure. The aim of the investments is to improve access by South Africans to healthcare facilities, schools, water, sanitation, housing and electrification. The plan also notes that investment in the construction of ports, roads, railway systems, ***electricity plants***, hospitals, schools and dams will contribute to improved economic growth.
Integrated Energy Plan	The development of a National IEP was envisaged in the White Paper on the Energy Policy of the Republic of South Africa of 1998 and, in terms of the National Energy Act, 2008 (Act No. 34 of 2008), the Minister of Energy is mandated to develop and, on an annual basis, review and publish the IEP in the Government Gazette. The purpose of the IEP is to provide a roadmap of the future energy landscape for South Africa which guides future energy infrastructure investments and policy development. The IEP notes that South Africa needs to grow its energy supply to support economic expansion and in so doing, alleviate supply bottlenecks and supply-demand deficits. In addition, it is essential that all citizens are provided with clean and modern forms of

APPLICABLE POLICY	DESCRIPTION OF POLICY
	energy at an affordable price. As part of the Integrated Energy Planning process, eight key objectives are identified, namely: — Objective 1: Ensure security of supply. — Objective 2: Minimise the cost of energy. — Objective 3: Promote the creation of jobs and localisation. — Objective 4: Minimise negative environmental impacts from the energy sector. — Objective 5: Promote the conservation of water. — Objective 6: Diversify supply sources and primary sources of energy. — Objective 7: Promote energy efficiency in the economy. — Objective 8: Increase access to modern energy. The IEP provides an assessment of current energy consumption trends within different sectors of the economy (i.e., agriculture, commerce, industry, residential and transport) and uses this information to identify future energy requirements, based on different scenarios. The scenarios are informed by different assumptions on economic development and the structure of the economy and also take into account the impact of key policies such as environmental policies, energy efficiency policies, transport policies and industrial policies, amongst others. Based on this information the IEP then determines the optimal mix of energy sources and technologies to meet those energy needs in the most cost-effective manner for each of the scenarios. The associated environmental impacts, socio-economic benefits and macroeconomic impacts are also analysed. The IEP is therefore focused on determining the long-term energy pathway for South Africa, taking into account a multitude of factors which are embedded in the eight objectives. As part of the analysis four key scenarios were developed, namely the Base Case, Environmental Awareness, Resource Constrained and Green Shoots scenarios: — The Base Case Scenario assumes that existing policies are implemented and will continue to shape the energy sector landscape going forward. It assumes moderate economic growth in the medium to long term. — The Environmental Awareness Scenario is characterised by more stringent emission limits and a more environmentally aware society, where a higher cost is placed on externalities caused by the supply of energy. — The Resource Constrained Scenario in which global energy commodity prices (i.e. coal, crude oil and natural gas) are high due to limited supply. — The Green Shoots Scenario describes an economy in which the targets for high economic growth and structural changes to the economy, as set out in the National Development Plan (NDP), are met. The IEP notes that South Africa should continue to pursue a diversified energy mix which reduces reliance on a single or a few primary energy sources. In terms of existing electricity generation capacity, the IEP indicates that existing capacity starts to decline notably from 2025, with significant plant retirement occurring in 2031, 2041 and 2048. By 2050 only 20% of the current electricity generation capacity remains. As a result, large investments are required in the electricity sector in order to maintain an adequate supply in support of economic growth. By 2020, various import options become available, and some new coal capacity is added along with new wind, solar and gas capacity. The mix of generation capacity technologies by 2050 is considerably more diverse than the current energy mix, across all scenarios. The main differentiating factors between the scenarios are the level of demand, constraints on emission limits and the carbon dioxide externality costs. In all scenarios the energy mix for electricity generation becomes more diverse over the period to 2050, with

APPLICABLE POLICY	DESCRIPTION OF POLICY
	coal reducing its share from about 85% in 2015 to 15–20% in 2050 (depending on the scenario). Solar, wind, nuclear, gas and electricity imports increase their share. The Environmental Awareness and Green Shoots scenarios take on higher levels of renewable energy. An assessment of each scenario against the eight objectives with reference to renewable energy notes while all scenarios seek to ensure that costs are minimised within the constraints and parameters of each scenario, the Base Case Scenario presents the least cost followed by the Environmental Awareness, Resource Constrained and Green Shoots scenarios respectively when total energy system costs are considered. In terms of promoting job creation and localisation potential the Base Case Scenario presents the greatest job creation potential, followed by the Resource Constrained, Environmental Awareness and Green Shoots scenarios respectively. In all scenarios, approximately 85% of total jobs are localisable. For electricity generation, most jobs result from solar technologies followed by nuclear and wind, with natural gas and coal making a smaller contribution. The Environmental Awareness Scenario, due to its stringent emission constraints, shows the lowest level of total emissions over the planning horizon. This is followed by the Green Shoots, Resource Constrained and Base Case scenarios. These trends are similar when emissions are considered cumulatively and individually by type.
National Protected Area Expansion Strategy, 2010	The NPAES areas were identified through a systematic biodiversity planning process. They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES. They are also not a replacement for fine scale planning which may identify a range of different priority sites based on local requirements, constraints and opportunities (NPAES, 2010). According to the NPAES, there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore **outside the NPAES focus area**.

2.3 PROVINCIAL AND MUNICIPAL LEGAL FRAMEWORK

Table 2-3: Provincial Plans

APPLICABLE PLAN	DESCRIPTION OF PLAN
Mpumalanga Growth and Development Path	The primary objective of the Mpumalanga Economic Growth and Development Path (MEGDP) (2011) is to foster economic growth that creates jobs, reduce poverty and inequality in the Province. The MEGDP identifies supporting the development of clean forms of energy such as wind and hydro power generation opportunities, as well as opportunities including gas production from landfill and organic waste, as one of the key interventions to facilitate growth and job creation in the manufacturing sector. A focal point of the MEGDP is massive investments in infrastructure as a key driver of job creation across the economy, with alternative energy production identified as one of the key opportunities in the Mpumalanga Economic sectors.
Mpumalanga Spatial Development Framework (MSDF), 2019	The Mpumalanga Spatial Development Framework (SDF) (2019) identifies that tourism is an important economic sector and has emerged as a robust driver of growth for emerging economies. The SDF also notes that a significant portion of Mpumalanga's land area is classified as Moderate to High-Very High agricultural potential which can be

APPLICABLE PLAN	DESCRIPTION OF PLAN
	utilised for agricultural production. However, there are other factors affecting the agricultural sector including loss of agricultural land to other activities, availability of water, contamination of the water used for irrigation by other economic activities, and access to the market. The SDF further notes that mining is the largest economic sector in the province and has assisted other sectors such as manufacturing and power generation, to grow in the province. However, the mining sector has posed some key challenges, including soil and water contamination and environmental pollution, development of mines on good agricultural soil thus threatening food security, restriction of animal movement due to open cast mining thus affecting the ecosystem etc. It also notes that Mpumalanga's manufacturing plants and coal fired power plants are the key polluters of air, with climate change also identified as a key challenge in the province. Therefore, the province must carefully design interventions that provide a gradual shift from mining oriented sectors to the sustainable economic sectors to maintain sustained growth of the provincial economy. The SDF notes that a significant amount of the country's electricity comes from coal-fired stations in Mpumalanga. It also observes that there is a steady increase in the demand for electricity in the province, mostly attributed to residential, commercial and industrial development, including mining and heavy industry. The Provincial SDF also notes that the abundance of coal has led to the development of many coal-fired power stations in the province, however these coalfields are depleting, therefore making it necessary to consider renewable power sources in Mpumalanga. The SDF also recognises that Mpumalanga's Coal Mining and Coal Fired Power Plant region (mainly the Highveld area) will be under immense pressure for environmental considerations and as a result, the region will witness a possible decline in demand of coal and large-scale employment. The SDF proposes to diversify the regional economy and facilitate the gradual transition of economic activities in the region.
Mpumalanga Industrial Development Plan	In terms of industry, the purpose of the Mpumalanga Industrial Development Plan (MIDP) (2015) is to promote the establishment of new industries and promote growth of existing industries in the province.
Mpumalanga Conservation Act (No. 10 of 1998)	This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project: — Various species are protected; — The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species. The Act provides lists of protected species for the Province. According to the Mpumalanga Nature Conservation Act, a permit is required for the removal of any species on this list.

Table 2-4: District and Local Municipality Plans

APPLICABLE PLAN	DESCRIPTION OF PLAN
Gert Sibande Municipality Integrated Development Plan	According to the Municipal Systems Act (Act 32 of 2000) (MSA), all municipalities have to undertake an Integrated Development Plan (IDP) process. The IDP is a legislative requirement thus it has legal status and supersedes all other plans that guide development at local government level. The Gert Sibande Municipality (GSM) IDP Review (2019/ 2020) and Final IDP (2020/2021) has identified the following development priorities: — Municipal Transformation and Organisational Development — Basic Service Delivery and Infrastructure Development — Local Economic Development — Municipal Financial Viability and Management — Good Governance and Public Participation — Spatial Development Analysis and Rationale The main goal and strategic objective of the Basic Service Delivery and Infrastructure Development priority is a reliable and sustainable service. One of the main strategic objectives for reaching the goal is the provision of basic services such as water and electricity to an approved minimum level of standards in a sustainable manner; as per the national guidelines.
Govan Mbeki Local Municipality IDP	The GMM Revised IDP (2020/2021) has identified the following key Municipal priorities: — Providing sustainable, quality services; — Enabling diversified local economic development and job creation; — Ensuring the financial sustainability of the Municipality; — Working together with our stakeholders; — Empowering our workforce; and — Ensuring sound corporate governance. The Vision, Mission and Values are informed by six Key Strategic objectives of which Strategic Objective 3, To facilitate and create an enabling environment for diversified local economic development, social cohesion, and job creation and Strategic Objective 5, To develop spatially integrated, safe communities and a protected environment, are relevant to the proposed development. The IDP also refers to the establishment of a Special Economic Zone (SEZ) in the GMM, including the establishment of an industrial park. The proposed Industrial Park is to be located on an identified portion of land north west of Secunda. The success of the park and other industrial developments in the GMM will be dependent on the provision of reliable energy.
Govan Mbeki Spatial Development Framework	The GMM SDF is informed by six strategic objectives, including: — Strategic Objective 1: Economic development and job creation supporting and guiding development; — Strategic Objective 2: Promoting education, training, and innovation; — Strategic Objective 3: Accommodating urbanisation and transforming human settlements; — Strategic Objective 4: Promote the development of the rural areas within GMM that can support sustainable economic, social, and engineering infrastructure;

APPLICABLE PLAN	DESCRIPTION OF PLAN
	— Strategic Objective 5: Protect biodiversity, water, and agricultural resources; and — Strategic Objective 6: Infrastructure Investment. Strategic Objective 1, 5 and 6 are relevant to the proposed development: — Strategic Objective (S0)1: Of specific relevance SO 1 refers to the need to diversify the local mining dependent economy by phasing in renewable energy options, which include concentrated solar power, wind, and natural gas, reducing dependence on coal resources. — Strategic Objective (SO) 5: Of specific relevance SO5 highlights the need to minimise the consumption of scarce environmental resources, particularly water, electricity and land and protect biodiversity, water, and agricultural resources. — Strategic Objective (SO) 6: Of specific relevance SO6 highlights the need to ensure efficient supply of electricity and water install green infrastructure, including renewable energy. The SDF also defines the urban edge for the local municipality. The Urban Edge is illustrated in **Figure** 2-1. The location of the powerline in relation to the urban edge is illustrated in **Figure 2-2**.

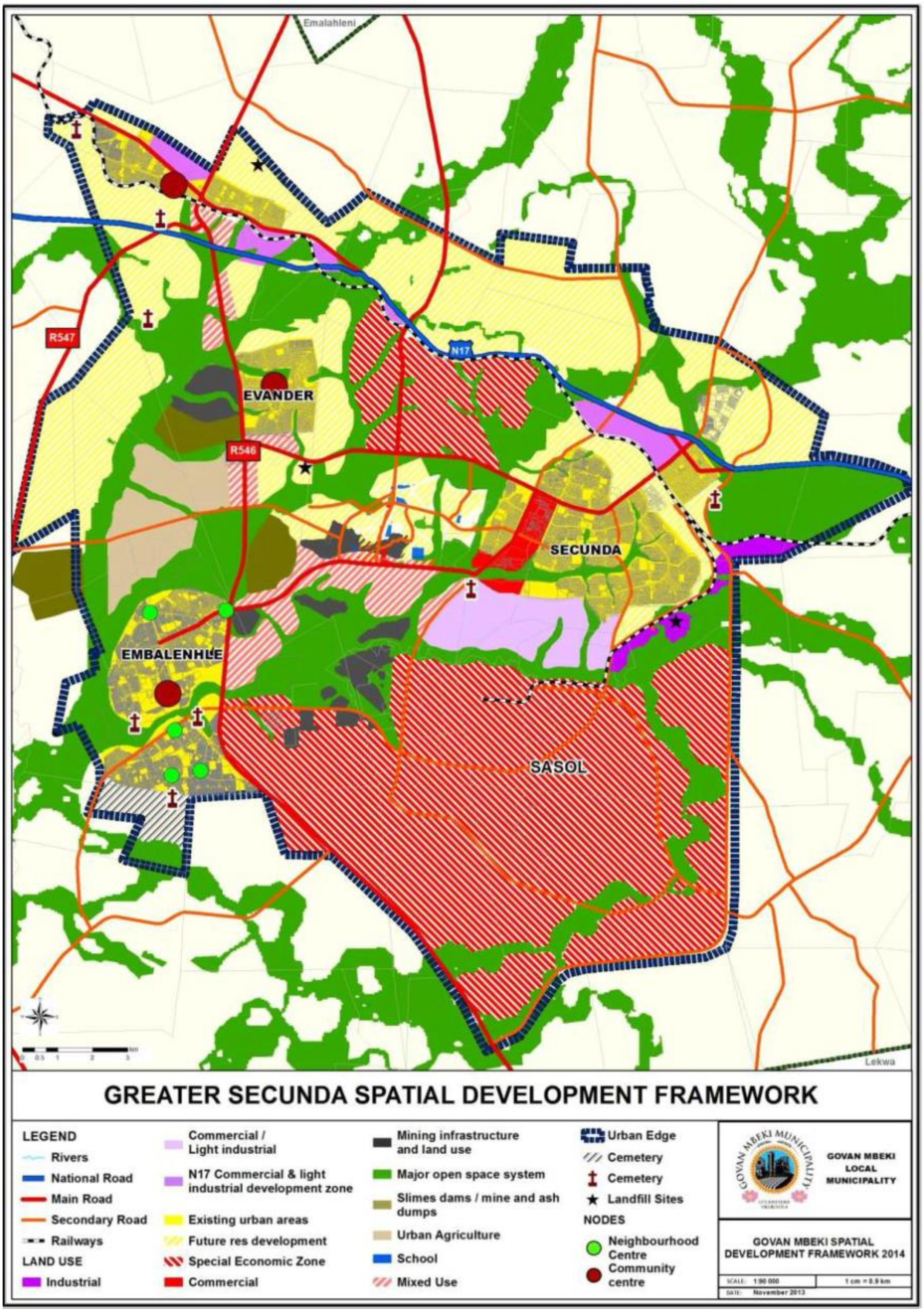


Figure 2-1: Greater Secunda Spatial Development Framework illustrating the Urban Edge

Figure 2-2: Location of the 132kV Powerline in relation to the Urban Edge (Red Line)

2.4 INTERNATIONAL ENVIRONMENTAL AND SOCIAL STANDARDS

2.4.1 IFC PERFORMANCE STANDARDS

The International Finance Corporation (IFC) is an international financial institution that offers investment, advisory, and asset management services to encourage private sector development in developing countries. The IFC is a member of the World Bank Group (WBG) and is headquartered in Washington, D.C., United States. It was established in 1956 as the private sector arm of the WBG to advance economic development by investing in strictly for-profit and commercial projects that purport to reduce poverty and promote development.

The IFC's stated aim is to create opportunities for people to escape poverty and achieve better living standards by mobilizing financial resources for private enterprise, promoting accessible and competitive markets, supporting businesses and other private sector entities, and creating jobs and delivering necessary services to those who are poverty-stricken or otherwise vulnerable. Since 2009, the IFC has focused on a set of development goals that its projects are expected to target. Its goals are to increase sustainable agriculture opportunities, improve health and education, increase access to financing for microfinance and business clients, advance infrastructure, help small businesses grow revenues, and invest in climate health.

The IFC is owned and governed by its member countries but has its own executive leadership and staff that conduct its normal business operations. It is a corporation whose shareholders are member governments that provide paid-in capital and which have the right to vote on its matters. Originally more financially integrated with the WBG, the IFC was established separately and eventually became authorized to operate as a financially autonomous entity and make independent investment decisions. It offers an array of debt and equity financing services and helps companies face their risk exposures, while refraining from participating in a management capacity. The corporation also offers advice to companies on making decisions, evaluating their impact on the environment and society, and being responsible. It advises governments on building infrastructure and partnerships to further support private sector development.

The IFC's Sustainability Framework articulates the Corporation's strategic commitment to sustainable development and is an integral part of IFC's approach to risk management. The Sustainability Framework comprises IFC's Policy and Performance Standards on Environmental and Social Sustainability, and IFC's Access to Information Policy. The Policy on Environmental and Social Sustainability describes IFC's commitments, roles, and responsibilities related to environmental and social sustainability. IFC's Access to Information Policy reflects IFC's commitment to transparency and good governance on its operations and outlines the Corporation's institutional disclosure obligations regarding its investment and advisory services. The Performance Standards (PSs) are directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of its direct investments (including project and corporate finance provided through financial intermediaries), IFC requires its clients to apply the PSs to manage environmental and social risks and impacts so that development opportunities are enhanced. IFC uses the Sustainability Framework along with other strategies, policies, and initiatives to direct the business activities of the Corporation to achieve its overall development objectives. The PSs may also be applied by other financial institutions (FIs).

The Project is considered a Category B project in terms of the IFC Policy on E&S Sustainability (2012), having the potential to cause limited adverse environmental or social risks and/or impacts that are few in number, generally site specific, largely reversible, and readily addressed through mitigation measures.

The objectives and applicability of the eight PSs are outlined in **Table 2-5.**

Table 2-5: IFC Performance Standards Applicability to the Project

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts			
Overview	Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders.		
Objectives	— To identify and evaluate environmental and social risks and impacts of the project. — To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment. — To promote improved environmental and social performance of clients through the effective use of management systems. — To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately. — To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.		
Aspects	1.1	Policy	

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
	1.2	Identification of Risks and Impacts	The IFC Standards state under PS 1 (Guidance Note 23) that "*the breadth, depth and type of analysis included in an ESIA must be proportionate to the nature and scale of the proposed project's potential impacts as identified during the course of the assessment process*." This document is the first deliverable from the BA process undertaken for the proposed Project. The impact assessment comprehensively assesses the key environmental and social impacts and complies with the requirements of the South African EIA Regulations. In addition, an EMPr has been compiled during this EIA phase of the project. A formal project specific ESMS will be compiled in the event that the project is developed in the future. Management and monitoring plans outlined in the EMPr (**Appendix G**) will serve as the basis for an ESMS for the proposed Project.
	1.3	Management Programmes	
	1.4	Organisational Capacity and Competency	
	1.5	Emergency Preparedness and Response	
	1.6	Monitoring and Review	
	1.7	Stakeholder Engagement	
	1.8	External Communication and Grievance Mechanism	
	1.9	Ongoing Reporting to Affected Communities	
Performance Standard 2: Labour and Working Conditions;			
Overview	Performance Standard 2 recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers.		
Objectives	— To promote the fair treatment, non-discrimination, and equal opportunity of workers. — To establish, maintain, and improve the worker-management relationship. — To promote compliance with national employment and labour laws. — To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain. — To promote safe and healthy working conditions, and the health of workers. — To avoid the use of forced labour.		
Aspects	2.1	— Working Conditions and Management of Worker Relationship — Human Resources Policy and Management — Working Conditions and terms of Engagement — Workers organisation — Non- Discrimination and Equal Opportunity — Retrenchment — Grievance Mechanism	The construction activities will require contractors for completion. A safe working environment and fair contractual agreements must be in place. The operational phase will have permanent employees for day-to-day activities as well as contractors who will all need a safe working environment and fair contractual agreements. Whilst PS2 will be applicable to the Project, it is not intended to be addressed in detail at the ESIA stage. Recommendations are provided concerning development of a detailed Human Resources (HR) and Occupational Health and Safety (OHS) system by the developer and its partners as the Project moves towards implementation. In addition, measures to address the Interim Advice for IFC Clients on Supporting Workers in the Context of COVID-19 are referenced. The EMPr (**Appendix G**) incorporates the requirements for compliance with local and international Labour and Working legislation and good practice on the part of the contractors.
	2.2	— Protecting the Workforce — Child Labour — Forced Labour	

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
	2.3	Occupational health and Safety	
	2.4	Workers Engaged by Third Parties	
	2.5	Supply Chain	
Performance Standard 3: Resource Efficiency and Pollution Prevention			
Overview	Performance Standard 3 recognises that increased economic activity and urbanisation often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use and pollution prevention and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world.		
Objectives	— To avoid or minimise adverse impacts on human health and the environment by avoiding or minimising pollution from project activities. — To promote more sustainable use of resources, including energy and water. — To reduce project related GHG emissions.		
Aspects	3.1	— Policy Resource Efficiency — Greenhouse Gases — Water Consumption	PS3-related impacts, such as the management of construction waste, hazardous substances, and stormwater are assessed in **Section 7** of this report. There are no material resource efficiency issues associated with the Project. The EMPr includes general resource efficiency measures (**Section 6 of Appendix G**). The project is not GHG emissions intensive and a climate resilience study or a GHG emissions-related assessment is not deemed necessary for a project of this nature. However, the Mukondeleli WEF seeks to facilitate resource efficiency and pollution prevention by contributing to the South African green economy. Dust air pollution in the construction phase has been adequately addressed in the EMPr (**Section 6** (**Air Quality Management**) **of Appendix G**). The Project will not result in the release of industrial effluents. Potential pollution associated with sanitary wastewater is low and mitigation measures have been included in the EMPr (**Appendix G)**. Land contamination of the site from historical land use (i.e. low intensity agricultural / grazing) is not considered to be a cause for concern. The waste generation profile of the project is not complex. Waste mitigation and management measures have been included in EMPr (**Appendix G)**. Hazardous materials are not a key issue; small quantities of construction materials (oil, grease, diesel fuel etc.) are the only wastes expected to be associated with the project. The EMPr identifies these anticipated hazardous materials and recommends relevant mitigation and management measures. Hazardous materials are not a key issue; small quantities of construction materials (oil, grease, diesel fuel etc.) are the only wastes expected
	3.2	— Pollution Prevention — Air Emissions — Stormwater — Waste Management — Hazardous Materials Management — Pesticide use and Management	

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
			to be associated with the project. The EMPr identifies these anticipated hazardous materials and recommends relevant mitigation and management measures (**Section 6 of Appendix G**).
Performance Standard 4: Community Health, Safety, and Security			
Overview	Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.		
Objectives	— To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances. — To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.		
Aspects	4.1	— Community Health and Safety — Infrastructure and Equipment Design and Safety — Hazardous Materials Management and Safety — Ecosystem Services — Community Exposure to Disease — Emergency Preparedness and Response	The requirements included in PS 4 will be addressed in the BA process and the development of the EMPr. During the construction phase there will be an increase in vehicular traffic along public roads, largely due to the need for importation of construction material. Pedestrian and road safety risks will be qualitatively evaluated in the BA process and the clients' standard safety and security measures, as well as potential additional measures recommended by WSP, are detailed in the EMPr (**Appendix G**).
	4.2	Security Personnel	
Performance Standard 5: Land Acquisition and Involuntary Resettlement			
Overview	Performance Standard 5 recognises that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use.		
Objectives	— To avoid, and when avoidance is not possible, minimise displacement by exploring alternative project designs. — To avoid forced eviction. — To anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. — To improve, or restore, the livelihoods and standards of living of displaced persons. — To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.		
Aspects	5.1	— Displacement — Physical Displacement — Economic Displacement	PS5 is not applicable to the proposed Mukondeleli 132kV Grid Connection as no physical or economic displacement or livelihood restoration will be required.

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
		— Private Sector Responsibilities under Government Managed Resettlement	The proposed Mukondeleli 132kV OHPL will traverse privately owned land that is utilised for agriculture by the landowners. The significance of all potential agricultural impacts is kept low by the very small proportion of the land that is impacted.
Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources			
Overview	Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development.		
Objectives	— To protect and conserve biodiversity. — To maintain the benefits from ecosystem services. — To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.		
Aspects	6.1	Protection and Conservation of Biodiversity	A significant part of the grid connection corridor falls within CBAs (Irreplaceable and Optimal) and some ESA Local and Landscape corridors are demarcated along the Mukondeleli 132kV OHPL corridor and substation locations. A Biodiversity Impact Assessment as well as an Avifaunal Impact Assessment and Freshwater Ecology Impact Assessment have been included in the EIA scope, **Appendix F** of this report. These specialist assessments comprise of a combination of literature review, in-field surveys and sensitivity mapping, as well as the assessment of impacts on biodiversity associated with the proposed project. This substantively complies with the PS 6 general requirements for scoping and baseline assessment for determination of biodiversity and ecosystem services issues, as well as the risks and impacts identification process requirements. The determination of habitat sensitivity was undertaken within the legal and best practice reference framework for South Africa. Specific mitigation and management measures for alien invasive species control are included in the EMPr (**Appendix G)**..
Performance Standard 7: Indigenous People			
Overview	Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded.		
Objectives	— To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. — To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts. — To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. — To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle.		

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
	— To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present. — To respect and preserve the culture, knowledge, and practices of Indigenous Peoples.		
Aspects	7.1	General — Avoidance of Adverse Impacts — Participation and Consent	As per the international instruments under the United Nations (UN) Human Rights Conventions, no indigenous peoples are present within the study area. The Project does not involve displacement. PS7 will not be triggered.
	7.2	Circumstances Requiring Free, Prior, and Informed Consent — Impacts on Lands and Natural Resources Subject to Traditional Ownership or Under Customary Use — Critical Cultural Heritage — Relocation of Indigenous Peoples from Lands and Natural Resources Subject to Traditional Ownership or Under Customary Use	
	7.3	Mitigation and Development Benefits	
	7.4	Private Sector Responsibilities Where Government is Responsible for Managing Indigenous Peoples Issues	
Performance Standard 8: Cultural Heritage			
Overview	Performance Standard 8 recognizes the importance of cultural heritage for current and future generations.		
Objectives	— To protect cultural heritage from the adverse impacts of project activities and support its preservation. — To promote the equitable sharing of benefits from the use of cultural heritage.		
Aspects	8.1	Protection of Cultural Heritage in Project Design and Execution	A Heritage Impact Assessment Report (**Appendix F-3**) has been carried out by a suitably qualified specialist, revealing that no archaeological sites of significance were noted, and finds were limited to several ruins and graves recorded in the Project area. Based on the current layout, none of the recorded sites will be directly impacted on. A Chance Find Procedure has been included in the EMPr (**Appendix G)**.

2.4.2 EQUATOR PRINCIPLES

The Equator Principles (EPs) is a risk management framework, adopted by financial institutions, for determining, assessing, and managing environmental and social risk in projects and is primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making.

The EPs apply globally to all industry sectors and to five financial products 1) Project Finance Advisory Services, 2) Project Finance, 3) Project-Related Corporate Loans, 4) Bridge Loans and 5) Project-Related Refinance and Project-Related Acquisition Finance. The relevant thresholds and criteria for application is described in detail in the Scope section of the EP. Currently 125 Equator Principles Financial Institutions (EPFIs) in 37 countries have officially adopted the EPs, covering the majority of international project finance debt within developed and emerging markets. EPFIs commit to implementing the EPs in their internal environmental and social policies, procedures and standards for financing projects and will not provide Project Finance or Project-Related Corporate Loans to projects where the client will not, or is unable to, comply with the EPs.

While the EPs are not intended to be applied retroactively, EPFIs apply them to the expansion or upgrade of an existing project where changes in scale or scope may create significant environmental and social risks and impacts, or significantly change the nature or degree of an existing impact. The EPs have greatly increased the attention and focus on social/community standards and responsibility, including robust standards for indigenous peoples, labour standards, and consultation with locally affected communities within the Project Finance market.

The EPs have also helped spur the development of other responsible environmental and social management practices in the financial sector and banking industry and have supported member banks in developing their own Environmental and Social Risk Management Systems.

The requirements and applicability of the EPs are outlined in **Table 2-6**.

It should be noted that Principles 8 and 10 relate to a borrower's code of conduct and are therefore not considered relevant to the S&EIR process and have not been included in this discussion.

Table 2-6: Requirements and Applicability of the Equator Principles

REQUIREMENT		PROJECT SPECIFIC APPLICABILITY
Principle 1: Review and Categorisation		
Overview	When a project is proposed for financing, the EPFI will, as part of its internal social and environmental review and due diligence, categorise such project based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the IFC. Using categorisation, the EPFI's environmental and social due diligence is commensurate with the nature, scale, and stage of the Project, and with the level of environmental and social risks and impacts. The categories are: — Category A: Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented; — Category B: Projects with potential limited adverse environmental and social risks and/or	Based upon the significance and scale of the Project's environmental and social impacts, the proposed project is regarded as a Category B project i.e. a project with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.

REQUIREMENT		PROJECT SPECIFIC APPLICABILITY
	impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and — Category C: Projects with minimal or no adverse environmental and social risks and/or impacts.	
Principle 2: Environmental and Social Assessment		
Overview	For all Category A and Category B Projects, the EPFI will require the client to conduct an appropriate Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and scale of impacts of the proposed Project (which may include the illustrative list of issues found in Exhibit II). The Assessment Documentation should propose measures to minimise, mitigate, and where residual impacts remain, to compensate/ offset/ remedy for risks and impacts to Workers, Affected Communities, and the environment, in a manner relevant and appropriate to the nature and scale of the proposed Project. The Assessment Documentation will be an adequate, accurate and objective evaluation and presentation of the environmental and social risks and impacts, whether prepared by the client, consultants or external experts. For Category A, and as appropriate, Category B Projects, the Assessment Documentation includes an Environmental and Social Impact Assessment (ESIA). One or more specialised studies may also need to be undertaken. For other Category B and potentially C Projects, a limited or focused environmental or social assessment may be appropriate, applying applicable risk management standards relevant to the risks or impacts identified during the categorisation process. The client is expected to include assessments of potential adverse Human Rights impacts and climate change risks as part of the ESIA or other Assessment, with these included in the Assessment Documentation.	This document is the <u>second</u> deliverable (i.e. <u>final</u> BAR) from the BA process undertaken for the proposed Project. The assessment appropriately and comprehensively assessed the key environmental and social impacts and complies with the requirements of the South African EIA Regulations and this Principle. In addition, an EMPr has been compiled and is included in **Appendix G**. A formal project specific ESMS will be compiled in the event that the project is developed in the future. Management and monitoring plans outlined in the EMPr will serve as the basis for an ESMS for the proposed Project.
Principle 3: Applicable Environmental and Social Standards		
Overview	The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. The EPFI's due diligence will include, for all Category A and Category B Projects globally, review and confirmation by the EPFI of how the Project and transaction meet each of the Principles. For Projects located in Non-Designated Countries, the Assessment process evaluates compliance with the then applicable IFC PS and WBG EHS Guidelines. For Projects located in Designated Countries, compliance	As South Africa has been identified as a non-designated country, the reference framework for environmental and social assessment is based on the IFC PS. In addition, this BA process has been undertaken in accordance with NEMA (the host country's relevant legislation).

REQUIREMENT		PROJECT SPECIFIC APPLICABILITY
	with relevant host country laws, regulations and permits that pertain to environmental and social issues.	
Principle 4: Environmental and Social Management System and Equator Principles Action Plan		
Overview	For all Category A and Category B Projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree on an Equator Principles Action Plan (EPAP). The EPAP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.	A formal project specific ESMS will be compiled in the event that the project is developed in the future. Management and monitoring plans outlined in the EMPr will serve as the basis for an ESMS for the proposed Project.
Principle 5: Stakeholder Engagement		
Overview	EPFI will require the client to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities Workers and, where relevant, Other Stakeholders. For Projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. To accomplish this, the appropriate assessment documentation, or non-technical summaries thereof, will be made available to the public by the borrower for a reasonable minimum period in the relevant local language and in a culturally appropriate manner. The borrower will take account of and document the process and results of the consultation, including any actions agreed resulting from the consultation. Disclosure of environmental or social risks and adverse impacts should occur early in the Assessment process, in any event before the Project construction commences, and on an ongoing basis. All Projects affecting Indigenous Peoples will be subject to a process of Informed Consultation and Participation, and will need to comply with the rights and protections for Indigenous Peoples contained in relevant national law, including those laws implementing host country obligations under international law.	Th BA process includes an extensive stakeholder engagement process which complies with the South African EIA Regulations. The process includes consultations with local communities, nearby businesses, and a range of government sector stakeholders (state owned enterprises, national, provincial and local departments). The stakeholder engagement process solicits interest from potentially interested parties through the placement of site notices and newspaper advertisements as well as written and telephonic communication. The stakeholder engagement process is detailed in Stakeholder Engagement Report (SER) included in **Appendix D.**

REQUIREMENT		PROJECT SPECIFIC APPLICABILITY
Principle 6: Grievance Mechanism		
Overview	For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish effective grievance mechanisms which are designed for use by Affected Communities and Workers, as appropriate, to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance. The borrower will inform the Affected Communities and Workers about the grievance mechanism in the course of the stakeholder engagement process and ensure that the mechanism addresses concerns promptly and transparently, in a culturally appropriate manner, and is readily accessible, at no cost, and without retribution to the party that originates the issue or concern.	The EMPr includes a *Grievance Mechanism Process for Public Complaints and Issues* (**Appendix G**). *Mechanism Process for Public Complaints and Issues*. This procedure effectively allows for external communications with members of the public to be undertaken in a transparent and structured manner.
Principle 7: Independent Review		
Overview	For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.	This principle will only become applicable in the event that that the project is developed in the future.
Principle 9: Independent Monitoring and Reporting		
Overview	To assess Project compliance with the Equator Principles after Financial Close and over the life of the loan, the EPFI will require independent monitoring and reporting for all Category A, and as appropriate, Category B projects. Monitoring and reporting should be provided by an Independent Environmental and Social Consultant; alternatively, the EPFI will require that the client retain qualified and experienced external experts to verify its monitoring information, which will be shared with the EPFI in accordance with the frequency required.	This principle will only become applicable in the event that the project is developed in the future.

2.4.3 INTERNATIONAL LABOUR STANDARDS

The International Labour Organisation (ILO) brings together governments, employers, and workers of 187 member states, to set labour standards, develop policies and devise programmes promoting decent work for all women and men. The ILO advocates and governs a set of International Labour Standards (ILS). The ILS is a system of standards that are fundamental, universal, and invisible human rights for all working people across the world. The aim of the international labour standards is to ensure that the growth the of the global economic provides benefits to all. These standards are legal instruments drawn up by ILO's constituents setting out basic principles and rights at work. These instruments are either Conventions (or Protocols), which are legally binding international treaties that may be ratified by member states, or recommendations, which serve as non-binding guidelines. The fundamental instruments of the ILO and ILS outlined in **Table 2-7**.

Table 2-7: Fundamental Instruments of the ILO and ILS.

INTERNATIONAL LABOUR STANDARDS: FUNDAMENTAL INSTRUMENTS	PROJECT SPECIFIC APPLICABILITY
1. Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87) 2. Right to Organise and Collective Bargaining Convention, 1949 (No. 98)	The Constitution of the Republic of South Africa (1996) allows for all workers to: — Section 18: Freedom of Association — Section 23: Labour Relations — Everyone has the right to fair labour practices; — Every worker has the right to form and join a trade union and to participate in the union's activities; — Every worker has the right to strike — Every employer has the right to form and join an employers' organization and to participate in the activities of the organization; and — Every trade union, employers' organization and employer has the right to engage in collective bargaining. The Mukondeleli WEF project (inclusive of the grid connection) shall abide by all laws and rights enshrined by The Constitution of The Republic of South Africa (1996).
3. Forced Labour Convention, 1930 (No. 29) (and its 2014 Protocol) 4. Abolition of Forced Labour Convention, 1957 (No. 105)	The South African Constitution (1996) and Basic Conditions of Employment Act (as amended) prohibits any forced labour in the country. Therefore, the Mukondeleli WEF project (inclusive of the grid connection) commits to not undertake any forced labour over the lifespan of the project. During the operational phase labour audits will be conducted on the project's main contractors and subcontractors.
5. Minimum Age Convention, 1973 (No. 138) 6. Worst Forms of Child Labour Convention, 1999 (No. 182)	According to the South African Basic Conditions of Employment Act and entrenched in the Constitution of the Republic of South Africa (1996), it is a criminal offence to employ a child younger than 15, except in the performing arts with a permit from the Department of Labour. Children aged 15 to 18 may not be employed to do work inappropriate for their age or work that place them at risk. The project will not employ individuals 18 years old or younger.
7. Equal Remuneration Convention, 1951 (No. 100) 8. Discrimination (Employment and Occupation) Convention, 1958 (No. 111)	This WEF project will follow The Promotion of Equality and Prevention of Unfair Discrimination Act, 2000 (PEPUDA or the Equality Act, Act No. 4 of 2000). This is a comprehensive South African anti-discrimination law. It prohibits unfair discrimination by the government and by private organisations and individuals and forbids hate speech and harassment.

INTERNATIONAL LABOUR STANDARDS: FUNDAMENTAL INSTRUMENTS	PROJECT SPECIFIC APPLICABILITY
	The project will ensure employment equity across all individuals employed by the project, and all employment opportunities will be free of discrimination.
9. Occupational Safety and Health Convention, 1981 (No. 155) 10. Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187)	The Mukondeleli WEF development (inclusive of the grid connection) will abide by the South African Occupational Health and Safety Act 85 of 1993. This act intends to: — to provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; — the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; — to establish an advisory council for occupational health and safety; and — to provide for matters connected therewith.

2.5 OTHER GUIDELINES AND BEST PRACTICE RECOMMENDATIONS

2.5.1 WORLD BANK GROUP ENVIRONMENTAL, HEALTH, AND SAFETY GUIDELINES

In support of the Performance Standards, the World Bank Group (WBG) has published a number of Environmental Health and Safety (EHS) Guidelines. The EHS Guidelines are technical reference documents that address IFC's expectations regarding the industrial pollution management performance of its projects. They are designed to assist managers and decision makers with relevant industry background and technical information. This information supports actions aimed at avoiding, minimising, and controlling EHS impacts during the construction, operation, and decommissioning phase of a project or facility. The EHS Guidelines serve as a technical reference source to support the implementation of the IFC Performance Standards, particularly in those aspects related to PS3: Pollution Prevention and Abatement, as well as certain aspects of occupational and community health and safety.

Where host country regulations differ from the levels and measures presented in the EHS Guidelines, projects seeking international funding may be expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is required.

The following IFC / WBG EHS Guidelines have been generally consulted during the preparation of the BA in order to aid the identification of EHS aspects applicable to the project

EHS GENERAL GUIDELINES

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of GIIP. They contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs.

The EHS General Guidelines contain information on cross-cutting environmental, health and safety issues potentially applicable to all industry sectors, used together with the relevant industry sector guideline(s), to guide the development of management and monitoring strategies for various project-related impacts.

EHS GUIDELINES FOR ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

The EHS Guidelines for Electric Power Transmission and Distribution (2007) include information relevant to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas.

The Guidelines includes industry-specific impacts and management, provides a summary of EHS issues associated with electric power transmission and distribution that occur during the construction and operation phases of a facility, along with recommendations for their management. Additionally, it includes performance indicators and monitoring related to the environment an occupational health and safety.

These Guidelines have been considered in the impact assessment and formulation of mitigation measures in this BAR.

2.5.2 GENERIC EMPR RELEVANT TO AN APPLICATION FOR SUBSTATION AND OVERHEAD ELECTRICITY TRANSMISSION AND DISTRIBUTION INFRASTRUCTURE

NEMA requires that an EMPr be submitted where an EIA has been identified as the environmental instrument to be utilised as the basis for a decision on an application for environmental authorisation. The content of an EMPr must either contain the information set out in Appendix 4 of the EIA Regulations, 2014, as amended, or must be a generic EMPr relevant to an application as identified and gazetted by the Minister in a government notice. Once the Minister has identified, through a government notice, that a generic EMPr is relevant to an application for EA, that generic EMPr must be applied by all parties involved in the EA process, including, but not limited to, the applicant and the CA.

GN 435 of 22 March 2019 identified a generic EMPr relevant to applications for substations and overhead electricity transmission and distribution infrastructure which require authorisation in terms of Section 42(2) of NEMA. Applications for overhead electricity transmission and distribution infrastructure that trigger Activity 11 of Listing Notice 1 or Activity 9 of Listing Notice 2 and any other listed or specified activities must use the generic EMPr.

The objective of the generic EMPr is "*to prescribe and pre-approve generally accepted impact management outcomes and impact management actions, which can commonly and repeatedly be used for the avoidance, management and mitigation of impacts and risks associated with the development or expansion of overhead electricity transmission and distribution infrastructure. The use of a generic EMPr is intended to reduce the need to prepare and review individual EMPrs for applications of a similar nature*."[2]

The generic EMPrs (for both OHPL and Substations) are attached in the Site-Specific EMPr included as **Appendix G.**

[2] DEA (2019) *Appendix 1: Generic Environmental Management Programme (EMPr) for the Development and Expansion for Overhead Electricity Transmission and Distribution Infrastructure*

3 BASIC ASSESSMENT PROCESS

3.1 OBJECTIVES OF THE BASIC ASSESSMENT PROCESS AS PER THE PROCEDURAL FRAMEWORK

As defined in Appendix 1 of the EIA Regulations, 2014 (as amended), the objective of the impact assessment process is to, through a consultative process:

— Determine the policy and legislative context within which the proposed activity is located and how the activity complies with and responds to the policy and legislative context;

— Identify the alternatives considered, including the activity, location, and technology alternatives;

— Describe the need and desirability of the proposed alternatives;

— Through the undertaking of an impact and risk assessment process, inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage, and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and technology alternatives on these aspects to determine—
  - The nature, significance, consequence, extent, duration, and probability of the impacts occurring to; and
  - The degree to which these impacts—
    - Can be reversed;
    - May cause irreplaceable loss of resources; and
    - Can be avoided, managed, or mitigated.

— Through a ranking of the site sensitivities and possible impacts the activity and technology alternatives will impose on the sites and location identified through the life of the activity to–
  - Identify and motivate a preferred site, activity and technology alternative;
  - Identify suitable measures to avoid, manage or mitigate identified impacts; and
  - Identify residual risks that need to be managed and monitored.

3.2 DFFE SCREENING WEB-BASED ENVIRONMENTAL TOOL

DFFE has developed the National Web-based Environmental Screening Tool in order to flag areas of potential environmental sensitivity related to a site as well as a development footprint and produces the screening report required in terms of regulation 16 (1)(v) of the EIA Regulations (2014, as amended). The Notice of the requirement to submit a report generated by the national web-based environmental screening tool in terms of section 24(5)(h) of the NEMA, 1998 (Act No 107 of 1998) and regulation 16(1)(b)(v) of the EIA regulations, 2014, as amended (GN 960 of July 2019) states that the submission of a report generated from the national web-based environmental screening tool, as contemplated in Regulation 16(1)(b)(v) of the EIA Regulations, 2014, published under Government Notice No. R982 in Government Gazette No. 38282 of 4 December 2014, as amended, is compulsory when submitting an application for environmental authorisation in terms of regulation 19 and regulation 21 of the EIA Regulations, 2014 as of 04 October 2019.

The Screening Report generated by the National Web-based Environmental Screening Tool contains a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development footprint as well as the most environmentally sensitive features on the footprint based on the footprint sensitivity screening results for the application classification that was selected.

Screening reports for the proposed 132kV OHPL, substations and BESS were generated on **08 November 2022** and 09 December 2022 respectively and are attached as **Appendix J**. The Screening Reports for the project identified various sensitivities for the site. The reports also generated a list of specialist assessments that should form part of the BA based on the development type and the environmental sensitivity of the site. Assessment Protocols in the report provide minimum information to be included in a specialist report to facilitate decision-making.

Table 3-1 below provides a summary of the sensitivities identified for the OHPL, substation and BESS footprints.

Table 3-1: Sensitivities identified in the screening report

THEME	VERY HIGH SENSITIVITY	HIGH SENSITIVITY	MEDIUM SENSITIVITY	LOW SENSITIVIY
132kV OHPL				
Agricultural Theme		✓		
Animal Species Theme			✓	
Aquatic Biodiversity Theme	✓			
Archaeological and Cultural Heritage Theme				✓
Civil Aviation Theme		✓		
Defence Theme				✓
Palaeontology Theme	✓			
Plant Species Theme			✓	
Terrestrial Biodiversity Theme	✓			
Mukondeleli Substation (Preferred)				
Agricultural Theme			✓	
Animal Species Theme			✓	
Aquatic Biodiversity Theme				✓

THEME	VERY HIGH SENSITIVITY	HIGH SENSITIVITY	MEDIUM SENSITIVITY	LOW SENSITIVIY
Archaeological and Cultural Heritage Theme				✓
Civil Aviation Theme			✓	
Defence Theme				✓
Palaeontology Theme			✓	
Plant Species Theme			✓	
Terrestrial Biodiversity Theme	✓			
Sasol Substation and BESS				
Agricultural Theme			✓	
Animal Species Theme			✓	
Aquatic Biodiversity Theme				✓
Archaeological and Cultural Heritage Theme				✓
Civil Aviation Theme		✓		
Defence Theme				✓
Palaeontology Theme	✓			
Plant Species Theme				✓
Terrestrial Biodiversity Theme	✓			

Based on the selected classification, and the environmental sensitivities of the proposed OHPL, substation and BESS t footprints, the following list of specialist assessments have been identified for inclusion in the assessment report as determined by the screening tool (please refer to Section 3.2.1 below for the EAP motivation applicable to this list):

- Agricultural Impact Assessment
- Archaeological and Cultural Heritage Impact Assessment
- Palaeontology Impact Assessment

- Terrestrial Biodiversity Impact Assessment
- Aquatic Biodiversity Impact Assessment
- Socio-Economic Assessment
- Civil Aviation Impact Assessment
- Défense Assessment
- Plant Species Assessment
- Animal Species Assessment

3.2.1 MOTIVATION FOR SPECIALIST STUDIES

The report recognises that "it is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the footprint situation."

As summarised in **Table 3-1** above, the following specialist assessments have been commissioned for the project based on the environmental sensitivities identified by the Screening Report:

- Soils and Agricultural Potential Assessment;
- Archaeological and Cultural Heritage Assessment;
- Palaeontology Impact Assessment;
- Visual Impact Assessment;
- Biodiversity Impact Assessment (inclusive of terrestrial biodiversity, plant species and animal species);
- Avifauna Impact Assessment;
- Social Impact Assessment;
- Qualitative Risk Assessment; and
- Desktop Geotechnical Assessment

Three of the identified specialist studies will not be undertaken as part of the BA process for the proposed Mukondeleli 132kV Grid Connection. Motivation for the exclusion of these specialist studies is provided below:

- **Detailed Geotechnical**

  A desktop Geotechnical Assessment has been commissioned and has been incorporated into the BAR. However, a detailed Geotechnical Assessment will not be undertaken as part of the BA Process as this will be undertaken during the detailed design phase.
- **Civil Aviation**

  According to the DFFE Screening Tool Report, civil aviation is regarded as having high sensitivity. The proposed development site is located between 8 and 15 km of civil aviation aerodromes. A formal Civil Aviation Assessment will not be undertaken as part of the S&EIA Process. Nevertheless, the relevant Authorities have been included on the project stakeholder database. As of the 1st of May 2021, Air Traffic and Navigation Services (ATNS) has been appointed as the new Obstacle application Service Provider for Windfarms and later Solar Plants. Their responsibility would pertain to the assessments, maintenance, and all other related matters in respect to Windfarms and in due time Power Plant assessments. An Application for the Approval of Obstacles will also be submitted to ATNS and the required permits will be obtained prior to the development of the project. The South African Civil Aviation Authority (SACAA) was included on the project stakeholder database. They will be informed of the proposed Project, and comment will be sought from these authorities as applicable.
- **Defence**

  The Department of Defence was included on the project stakeholder database. They will be informed of the proposed Project, and comment will be sought from this authority as applicable

3.3 APPLICATION FOR ENVIRONMENTAL AUTHORISATION

The application phase consisted of a pre-application consultation with MDARDLEA and subsequently completing the appropriate application form as well as the submission and registration of the application for EA with the MDARDLEA. The pre-application meeting was held with DFFE on **14 July 2022** (meeting minutes attached as **Appendix I**) and the application form was submitted to the MDARDLEA on **19 January 2023**. Reference number 1/3/1/16/1G-276 was issued on 23 January 2023 and have been included in, this report, the Final BAR.

3.4 BASELINE ENVIRONMENTAL ASSESSMENT

The description of the environmental attributes of the Project area was compiled through a combination of desktop reviews and site investigations. Desktop reviews made use of available information including existing reports, aerial imagery, and mapping. The specialist teams undertook site investigations between December 2021 and October 2022 to provide impact assessments for the proposed transmission line route.

3.5 IMPACT ASSESSMENT METHODOLOGY

3.5.1 ASSESSMENT OF IMPACTS AND MITIGATION

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct,[3] indirect,[4] secondary[5] as well as cumulative[6] impacts.

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects is determined and ranked by considering the criteria[7] presented in **Table 3-2**.

[3] Impacts that arise directly from activities that form an integral part of the Project.
[4] Impacts that arise indirectly from activities not explicitly forming part of the Project.
[5] Secondary or induced impacts caused by a change in the Project environment.
[6] Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.
[7] The definitions given are for guidance only, and not all the definitions will apply to all the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

Table 3-2: Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

3.5.2 IMPACT MITIGATION

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The mitigation sequence/hierarchy is shown in **Figure 3-1** below.

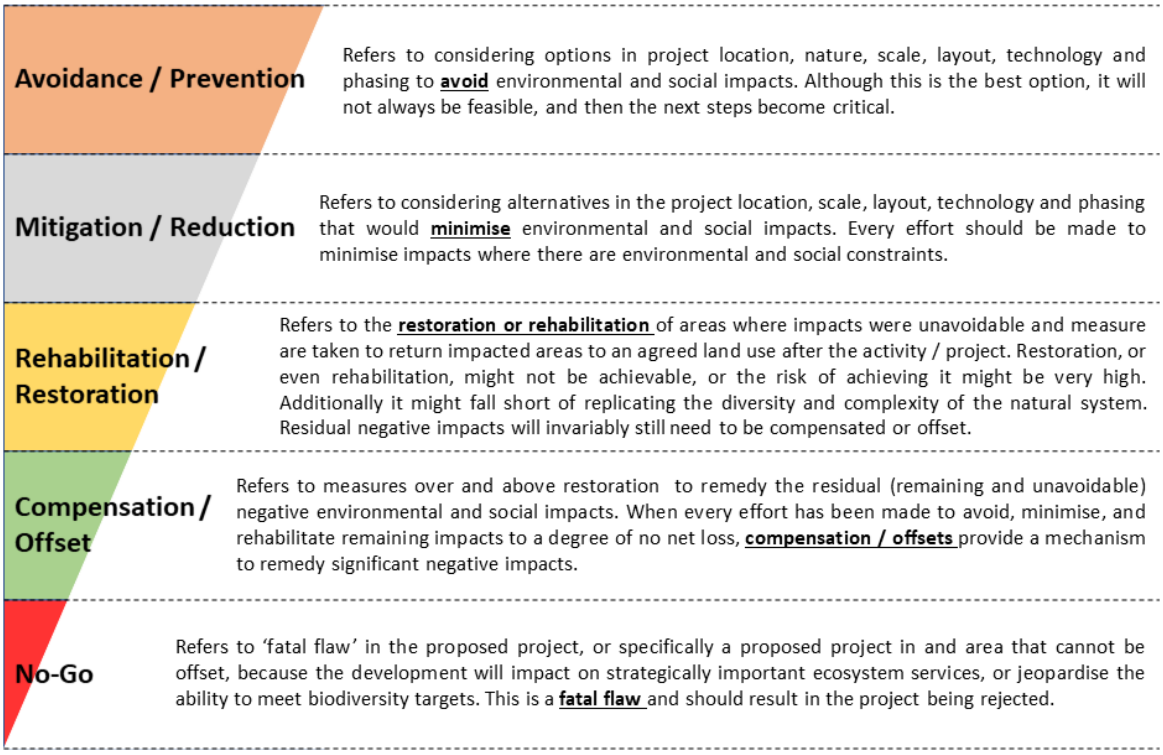


Figure 3-1: Mitigation Sequence/Hierarchy

The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan.

3.6 STAKEHOLDER ENGAGEMENT PROCESS

Stakeholder engagement (public participation) is a requirement of the BA process. It consists of a series of inclusive and culturally appropriate interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the BA decision-making process. Effective engagement requires the prior disclosure of relevant and adequate project information to enable stakeholders to understand the risks, impacts, and opportunities of the proposed project. The objectives of the stakeholder engagement process can be summarised as follows:

— Identify relevant individuals, organisations and communities who may be interested in or affected by the proposed project;

- Clearly outline the scope of the proposed project, including the scale and nature of the existing and proposed activities;
- Identify viable proposed project alternatives that will assist the relevant authorities in making an informed decision;
- Identify shortcomings and gaps in existing information;
- Identify key concerns, raised by Stakeholders that should be addressed in the specialist studies;
- Highlight the potential for environmental impacts, whether positive or negative; and
- To inform and provide the public with information and an understanding of the proposed project, issues, and solutions.

A Stakeholder Engagement Report (SER) has been included in **Appendix D** and will be updated in the final BAR, detailing the project's compliance with Chapter 6 of the NEMA EIA Regulations 2014, as amended.

3.6.1 PUBLIC REVIEW

The Final BAR was placed on public review for a period of 30 days from **19 January 2023** and **20 February 2023**, at the following public places:

- Gert Sibande District Municipality;
- Secunda Public Library
- WSP website (https://www.wsp.com/en-ZA/services/public-documents); and
- Datafree Website (https://wsp-engage.com/).

All registered stakeholders and authorising/commenting state departments were notified of the public review period as well as the locations of the draft BAR via email and SMS.

3.6.2 COMMENT AND RESPONSE REPORT

All concerns, comments, viewpoints and questions (collectively referred to as 'issues') will continue to be documented and responded to adequately in the Comment and Response Report. The Comment and Response Report records the following:

- List of all issues raised;
- Record of who raised the issues;
- Record of where the issues were raised;
- Record of the date on which the issue was raised; and
- Response to the issues.

WSP will collate the comments received during the public review phase and will compile a Comments and Responses Report (CRR) that will be included in the SER and attached to the Final BAR **.**

3.6.3 NOTIFICATION OF ENVIRONMENTAL AUTHORISATION

All stakeholders will receive a letter at the end of the process notifying them of the authority's decision, thanking them for their contributions, and explaining the appeals procedure as outlined in the national Appeal Regulations, 2014 (GNR 993 of 2014).

3.7 ASSUMPTIONS AND LIMITATIONS

General assumptions and limitations relating to the BA process are listed below:

— The information provided by Mukondeleli, and the specialists is assumed to be accurate;

— WSP's assessment of the significance of impacts of the proposed project on the affected environment has been based on the assumption that the activities will be confined to those described in Section 4. If any substantial changes to the project description are made, impacts may need to be reassessed;

— Where detailed design information is not available, the precautionary principle (i.e. a conservative approach that overstates negative impacts and understates benefits) has been adopted;

— The competent authority would not require additional specialist input, as per the proposals made in this report, in order to make a decision regarding the application; and

— All information is assumed to be accurate and relevant at the time of writing this report.

Aquatic

— The information provided by the client forms the basis of the planning and layouts discussed.

— All watercourses within 500 m of any developmental activities should be identified as per the DWS authorization regulations. In order to meet the timeframes and budget constraints for the project, watercourses within the study sites were delineated on a fine scale based on detailed soil and vegetation sampling. Watercourses that fall outside of the site, but that fall within 100 m of the proposed activities were delineated based on desktop analysis of vegetation gradients visible from aerial imagery.

— For the aquatic zoological site visit conducted on the 3rd to the 7th of January 2022, site access was an issue and not all sites could be visited. Access was arranged to sites situated within the Sasol boundary and the sites were revisited on the 3rd and 5th of February 2022, during this site visit water levels were too high and flood conditions were observed. The site visit was re-scheduled and conducted on the 22nd to the 24th of February 2022.

— This report as well as impact assessment methodology was provided to the specialist by the WSP as per contractual agreement.

— The detailed field visit for the wetland specialist was conducted from a once off field trip and thus would not depict any seasonal variation in the wetland plant species composition and richness.

— In order to obtain a comprehensive understanding of the dynamics of the aquatic ecosystem in an area, ecological assessments should always consider investigations at different time scales (across seasons/years) and through replication, as river systems are in constant change.

— As aquatic systems are directly linked to the frequency and quantity of rain it will influence the systems drastically. If studies are done during dry months or dry seasons, the accuracy of the report's findings could be affected.

— Description of the depth of the regional water table and geohydrological and hydropedological processes falls outside the scope of the current assessment

— Floodline calculations fall outside the scope of the current assessment.

— A Red Data scan, fauna and flora, and aquatic assessments were not included in the current study

— Species composition described for landscape units aimed at depicting characteristic species and did not include a survey for cryptic or rare species.

— The recreation grade GPS used for wetland and riparian delineations is accurate to within five meters.

— Watercourses delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, during the course of converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. It is therefore suggested that the no-go areas identified in the current report be pegged in the field in collaboration with the surveyor for precise boundaries. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by for example photocopying and printing.

— The calculation of buffer zones does not take into account climate change or future changes to watercourses resulting from increasing catchment transformation.
— No Mitigation Hierarchy or alternative layouts were discussed since this information was not available at the time of the assessment. This constitutes an important limitation to the study and should be included in an updated version of the assessment in order to provide a 'big picture 'view of the project.
— Findings, recommendations and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. The methods used for biomonitoring often require the author to make a predicted estimation based on prior knowledge and learning. These are however the methods as requested by the client and also accepted methods in the field of aquatic ecology.
— Sampling by its nature means that the entire study area cannot be assessed. In this case, the entirety of the study site could not be assessed due to time constraints and access restrictions. Therefore, the assessment findings are only applicable to the areas sampled and extrapolated to the rest of the study site.
— Due to the large extent of the study site several areas did not have access, and extrapolation was used here. It is advised that additional studies be conducted during the installation phase and the footprint of each wind turbine is assessed and possibly moved if need be.
— Large floods effected the area during the initial field visit, leading to many inaccessible roads and areas. A follow up study is suggested for any field gaps.
— Several changes were made to the layout after the initial fieldwork was conducted, therefore not all section were assessed on a fine scale. Ideally these areas should be revisited during a walk down prior to construction in order to ensure that no wetlands are overlooked.

Avifauna

This study made the basic assumption that the sources of information used are reliable and accurate. The following must be noted:

— The focus of the study was primarily on the potential impacts of the proposed on-site substation and 132kV overhead power line on powerline sensitive species.
— Powerline sensitive species were defined as species which could potentially be impacted by powerline collisions or electrocutions, based on their morphology. Larger birds, particularly raptors and vultures, are more vulnerable to electrocution as they are more likely to bridge the clearances between electrical components than smaller birds. Large terrestrial species and certain waterbirds with high wing loading are less manoeuvrable than smaller species and are therefore more likely to collide with overhead lines.
— The assessment of impacts is based on the baseline environment as it currently exists in the PAOI, as well as the broader are comprising the six SABAP2 pentads associated with the Mukondeleli Grid Connection project site.
— The SABAP2 dataset is a comprehensive dataset which provides a reasonably accurate snapshot of the avifauna that could occur at the proposed site. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, and the results of the pre-construction monitoring which was conducted over 12 months.
— Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
— Information on the proposed grid connections of renewable energy projects within a 30km radius around the project was sourced from public documents available on the internet. In some instances, information was not readily available, or specifications may have changed, therefore the confidence in the information is moderate.

- Conclusions drawn in this study are based on experience of the specialists on the species found on site and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.

Biodiversity

The following assumptions, limitations or uncertainties are listed regarding the evaluation of the impacts of the proposed Mukondeleli project on the terrestrial biodiversity and ecology:

- The area has been moderately collected in the past and the list of plant species that could potentially occur on site as obtained from the NewPosa database, is thus considered to provide a fair representation of the flora on site.
- Rare and threatened plant and animal species are generally uncommon and/or localised and the once-off survey may fail to locate such species. Information on rare and threatened plant and animal species was
- supplemented by data provided by MTPA (M. Lötter) on localities of such species at farm level.
- Rare plant species usually occur in specialised and localised habitats, thus special attention was given to these habitats.
- The site visit was undertaken in December 2021 after the region had received good rains, thus the botanical assessment was conducted under favourable conditions.
- No aerial census, road census or trapping (either camera trapping or by way of Sherman traps) was conducted for fauna, since these methods generally provide an underrepresentation of the full faunal diversity within the limited timeframe available. Faunal lists were sourced from literature and the website of the Animal Demography Unit of the University of Cape Town.

Heritage

- The field study was carried out at the surface only and hence any completely buried archaeological sites would not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. He survey was done for the associated WEF and thus only covered those sections of the powerline within the WEF area. Although much of the line was therefore not surveyed in the field, it is noted that large parts are already disturbed either through being under agriculture, being alongside/between existing roads or being within the already cleared Sasol Facility area. Furthermore, ground visibility on site was very limited due to the season and in practice most of the few sites recorded within the WEF area were visible on aerial photography. Aerial photography has been consulted for this project and it is assumed that the reduced fieldwork is thus not a significant limitation.
- Cumulative impacts are difficult to assess due to the variable site conditions that would have been experienced in different areas and in different seasons. Survey quality is thus likely to be variable. As such, some assumptions need to be made in terms of what and how much heritage might be impacted by other developments in the broader area.

Palaeontology

- Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and only some contain fossil plant, insect, invertebrate and vertebrate material. The dolerite and the overlying soils and sands of the Quaternary period would not preserve fossils. It is not known if the project excavations will reach the shales below ground, or if the shales have any fossil plants preserved in them. There are no coal mines in the project footprint so it is unlikely that any coal seams of economic value are present. It is known that dolerite destroys any fossils in its vicinity as the hot lava bakes the adjacent sediments through which it intrudes.

Socio-economic

- Technical suitability: The strategic importance of promoting renewable energy and associated grid infrastructure is supported by the national and provincial energy policies.

- Fit with planning and policy requirements: Legislation and policies reflect societal norms and values. The legislative and policy context therefore plays an important role in identifying and assessing the potential social impacts associated with a proposed development. In this regard a key component of the SIA process is to assess the proposed development in terms of its fit with key planning and policy documents. As such, if the findings of the study indicate that the proposed development in its current format does not conform to the spatial principles and guidelines contained in the relevant legislation and planning documents, and there are no significant or unique opportunities created by the development, the development cannot be supported. However, the study recognises the strategic importance of renewable energy and the technical, spatial and land use constraints required for renewable energy facilities and the associated grid infrastructure.
- Demographic data: The information contained in some key policy and land use planning documents, such as Integrated Development Plans etc., may not contain data from Community Household Survey if 2016. However, this will not have a material impact on the findings of the study

Visual

Assumptions, knowledge gaps and limitations relevant to this study are outlined below:

- This visual study has been undertaken based on the project description provided by the Developer and the Environmental Assessment Practitioner (EAP) at the inception of the project.
- Powerlines are very large structures by nature and could impact on receptors that are located relatively far away, particularly in areas of very flat terrain. Given the nature of the receiving environment and the height of the various components of the proposed development, the study area or visual assessment zone is assumed to encompass a zone of 5 km from the outer boundary of the combined powerline assessment corridors. This 5 km limit on the visual assessment zone relates to the importance of distance when assessing visual impacts. Although the proposed development may still be visible beyond 5 km, the degree of visual impact would be diminished considerably and as such the need to assess the impact on potential receptor locations beyond this distance would not be warranted.
- The identification of visual receptors involved a combination of desktop assessment as well as field-based observation. Initially Google Earth imagery was used to identify potential receptors within the study area. Where possible, these receptor locations were verified and assessed during a site visit which was undertaken between the 25th and 26th of January 2022. Due to the extent of the study area however and the number of receptors that could potentially be sensitive to the proposed development, it was not possible to visit or verify every potentially sensitive visual receptor location. As such, several broad assumptions have been made in terms of the likely sensitivity of the receptors to the proposed development. It should be noted that not all receptor locations would necessarily perceive the proposed development in a negative way. This is usually dependent on the use of the facility, the economic dependency of the occupants on the scenic quality of views from the facility and on people's perceptions of the value of "Green Energy". Sensitive receptor locations typically include sites such as tourism facilities and scenic locations within natural settings which are likely to be adversely affected by the visual intrusion of the proposed development. Thus, the presence of a receptor in an area potentially affected by the proposed development does not necessarily mean that any visual impact will be experienced.
- The potential visual impact at each visual receptor location was assessed using a matrix developed for this purpose. The matrix is based on three main parameters relating to visual impact and, although relatively simplistic, it provides a reasonably accurate indicative assessment of the degree of visual impact likely to be experienced at each receptor location as a result of the proposed development. It is however important to note the limitations of quantitatively assessing a largely subjective or qualitative type of impact and as such the matrix should be seen merely as a representation of the likely visual impact at a receptor location.
- The exact status of all the receptors could not be verified during the field investigation and as such the receptor impact rating was largely undertaken via desktop means.
- Receptors that were assumed to be farmsteads were still regarded as being potentially sensitive to the visual impacts associated with the proposed development and were thus assessed as part of the VIA.

- Based on the project description provided by the Developer, all analysis for this VIA is based on a worst-case scenario where the maximum height of powerline towers and associated structures is assumed to be 40m.
- Due to the varying scales and sources of information; maps may have minor inaccuracies. Terrain data for this area, derived from the NGI's 5 m Contour Database, is fairly coarse and somewhat inconsistent and as such, localised topographic variations in the landscape may not be reflected on the DEM used to generate the viewshed(s) and visibility analysis conducted in respect of the proposed development.
- In addition, the viewshed analysis did not take into account any existing vegetation cover or built infrastructure which may screen views of the proposed development. This analysis should therefore be seen as a conceptual representation or a worst-case scenario.
- No feedback regarding the visual environment has been received from the public participation process to date. All feedback from the public during the review period of the draft Basic Assessment Report (DBAR) have been incorporated into this report, if relevant.
- This study includes a broad assessment of the potential cumulative impacts of other renewable energy developments on the existing landscape character and on the identified sensitive receptors. This assessment is based on the information available at the time of writing the report and where information has not been available, broad assumptions have been made as to the likely impacts of these developments.
- No visualisation modelling was undertaken for the proposed development as this is not normally required for linear infrastructure. This can however be provided should the Public Participation process identify the need for this exercise.
- It should be noted that the site visit was undertaken in late January 2022, during mid-summer, which is characterised by higher levels of rainfall and increased vegetation cover. In these conditions, slightly reduced levels of visual impact will be experienced from receptor locations in the surrounding area.
- In clear weather conditions, powerlines and associated infrastructure would present a greater contrast with the surrounding landscape than they would on a cloudy overcast day. The field investigation was conducted during clear to partly cloudy weather conditions.

Agriculture

- There are no specific assumptions, uncertainties or gaps in knowledge or data that affect the findings of this study.

Geotechnical (Desktop study):

- The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimize the risks associated with the groundworks for this project. The document is not intended to reduce the level of responsibility accepted by WSP, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

4 PROJECT DESCRIPTION

This section provides a description of the location of the project area and the site location alternatives considered for the project. The descriptions encompass the activities to be undertaken during the construction and operational phases as well as the consideration for site accessibility, water demand, supply, storage, and site waste management. This section also considers the need and desirability of the project in accordance with Appendix 1 of GNR 326.

4.1 LOCATION OF THE PROPOSED PROJECT

The proposed Project is located in the Govan Mbeki Local Municipality under the jurisdiction of the Gert Sibande District Municipality, near the town of Secunda, in the Mpumalanga Province of South Africa (**Figure 4-1**). The proposed Project entails the construction of a 132 kV OHPL from the onsite substation at the proposed Mukondeleli WEF to connect to a private off-taker substation located inside the Sasol Secunda Primary Area. The project area covers 11 farm portions as shown in **Table 4-1**.

Table 4-1: Farm portions on which the proposed development is located

PORTION NUMBER	FARM NUMBER	FARM NAMES	21 DIGIT SURVEYOR GENERAL CODE OF EACH CADASTRAL LAND PARCEL
2	317	van Tondershoek	T0IS00000000031700002
4	291	Bojesspruit	T0IS00000000029100004
8	291	Bosjesspruit	T0IS00000000029100008
9	291	Bosjesspruit	T0IS00000000029100009
10	291	Bosjesspruit	T0IS00000000029100010
12	317	van Tondershoek	T0IS00000000031700012
3	285	Twistdraai	T0IS0000 00000285 00003
5	285	Twistdraai	T0IS0000 00000285 00005
6	285	Twistdraai	T0IS0000 00000285 00006
0	318	Brandspruit	T0IS00000000031800000
3	318	Brandspruit	T0IS0000 00000318 00003

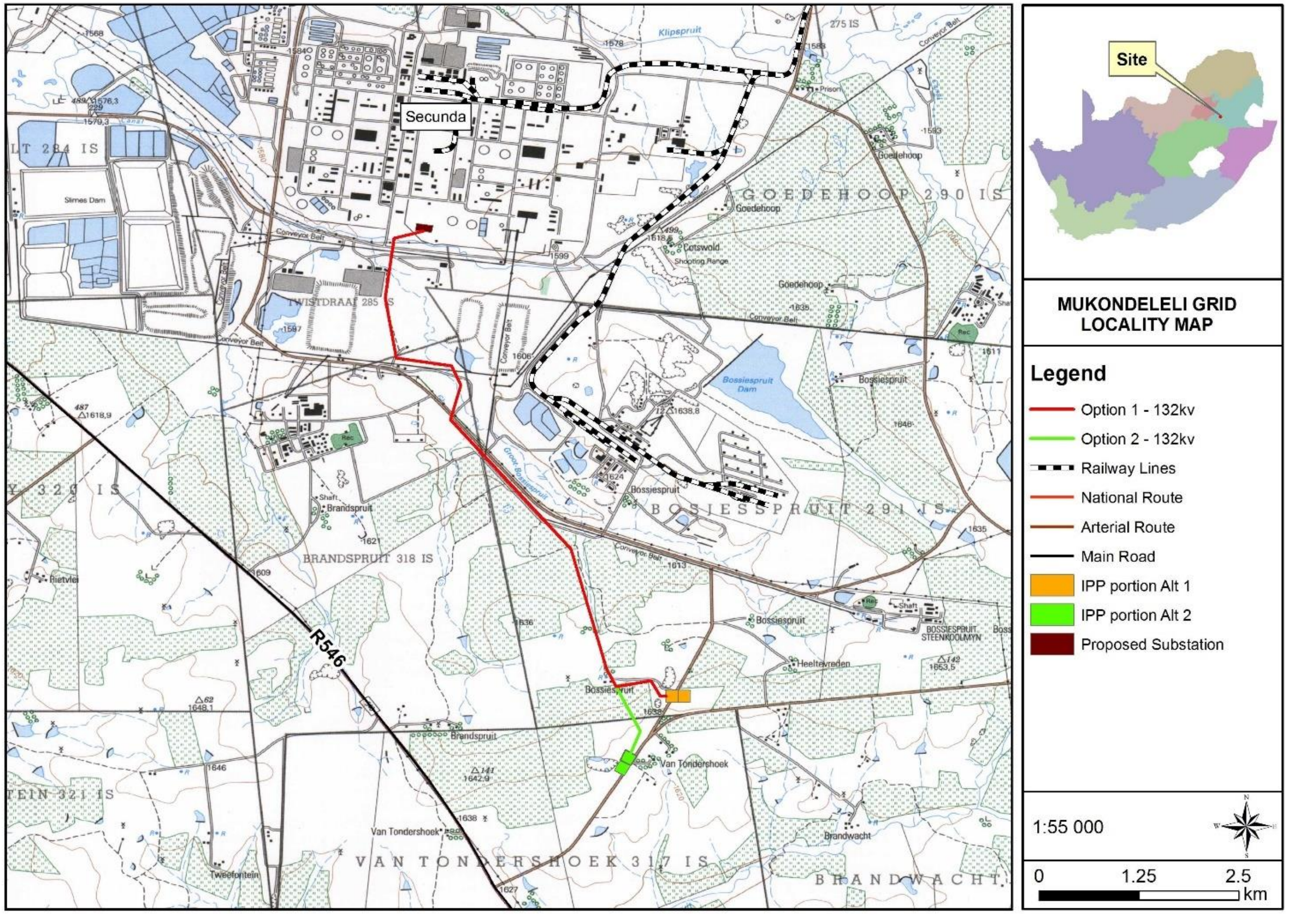


Figure 4-1: Locality Map of the proposed Mukondeleli up to 132 kV grid connection transmission line

4.2 ELECTRICITY POWER TRANSMISSION AND DISTRIBUTION

Electricity is carried at high voltages (kilovolts, or kV) along transmission lines in order to reduce the electrical losses that occur over long distances between power generation and consumption points. In order for electricity to be transmitted safely and efficiently over long distances, it must be at a high voltage and a low current.

The voltages at which power is generated at the power generation facility are too low for transmission over long distances. To overcome this problem, transformers are installed at the power stations and substations to increase the voltage level. Transformer's step-up the voltage from, for example, 11 or 22 kV to higher voltages such as 66 kV, 132kV, 220 kV, 275 kV, 400 kV or 765 kV, and feed the generated power into the substation located within the Sasol site.

When the electricity arrives at a distribution substation, bulk supplies of electricity are taken for primary distribution to towns and industrial areas, groups of villages, farms and similar concentrations of consumers. The lines are fed into intermediate substations where transformers reduce (step-down) the voltage level. This could be 11 kV in large factories and 380/220 Volts in shops and homes. Power is distributed to end-users via reticulation power lines and cables.

As of March 2019, South Africa's transmission network comprised 32,802 km of line length, 167 substations and 152,135 MVA of transformer capacity. All the high voltage lines, plus the transformers and related equipment, form the transmission system also known as the national grid.

4.2.1 COMPONENTS OF A TYPICAL TRANSMISSION LINE SYSTEM

The main components of a typical electrical transmission system include the following:

TRANSMISSION STRUCTURES

Transmission structures are the most visible components of the power transmission system. Their function is to inter alia, keep the high-voltage conductors separated from their surroundings and from each other. Some structure designs reflect the specific function of the structure, while others have come about as a result of technological progress. Structure design alternatives for this project are discussed in Section 5.2.

CONDUCTORS

Conductors carry the power through and from the grid. Generally, several conductors per phase are strung from structure to structure. The number of conductors per phase depends on the performance of the line, typically, more than one conductor per phase is used when the operating voltage exceeds 132kV. Conductors are constructed primarily of aluminium, aluminium-alloy, steel or other types of materials as appropriate.

SUBSTATIONS

The very high voltages used for power transmission are converted at substations to lower voltages for further distribution and consumer use. Substations vary in size and configuration but may cover several hectares; they are cleared of vegetation and typically surfaced with gravel. They are fenced, and are normally reached by a permanent access road. In general, substations include a variety of indoor and outdoor electrical equipment such as switchgear, transformers, control and protection panels and batteries, and usually include other components such as control buildings, fencing, lighting etc.

For the substation to perform it needs sophisticated protection equipment to detect faults and abnormal conditions that may occur on the network. Action may consist for example, of automatically tripping a transmission line to cater for abnormal conditions such as lightning strikes, fires or trees falling on transmission lines. This action is necessary for safety reasons in the event of an accident or to maintain electricity supply and limit the disruption caused.

Figure 4-2 provides an illustration of a typical substation layout.

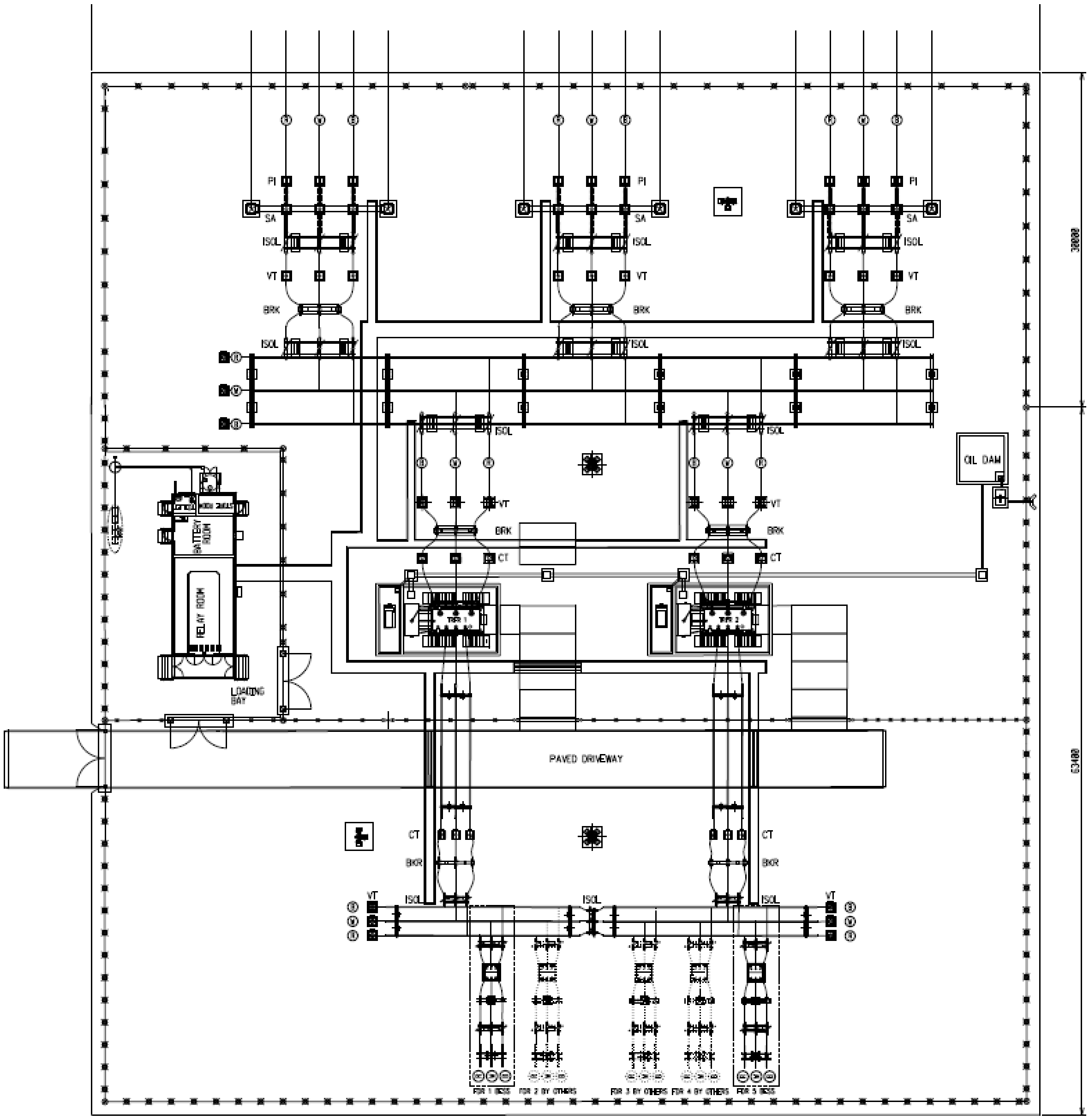


Figure 4-2: Typical Substation Layout

TRANSFORMERS

Transformers are major items found in a transmission or distribution substation. There may be a number of different types of transformers in a substation such as power transformers, voltage transformers or current transformers.

A power transformer is a very simple device piece of electrical equipment where alternating current (AC) is led through a primary coil of wire, which produces an alternating magnetic field in the ring-shaped core of soft iron. This in turn creates a voltage in a secondary coil, from which the output current can be drawn. If the secondary coil has more turns than the primary coil, the output voltage is higher than the input voltage. This is a step-up transformer. A step-down transformer has more turns in the primary coil than in the secondary coil to reduce the voltage.

4.3 PROJECT INFRASTRUCTURE

The proposed project entails the construction of 1 x up to 132kV OHPL from the Alternative 1 substation (preferred Mukondeleli WEF onsite substation) to the private off taker substation at Sasol Secunda. The proposed project will comprise the following key components:

- Construction of 1 x up to 132kV OHPL (either single or double circuit) between the Mukondeleli WEF onsite substation (Alternative 1 preferred substation) to the private offtaker substation at Sasol Secunda. The powerline will have a 250m assessment corridor to allow for micro-siting.
- Establishment of the substation (with a footprint of approximately 2 ha) at the preferred Mukondeleli substation area.
- Standard substation electrical equipment, i.e., transformers, busbars, office area, operation and control room, workshop, and storage area, feeder bays, transformers, busbars, stringer strain beams, insulators, isolators, conductors, circuit breakers, lightning arrestors, relays, capacitor banks, batteries, wave trappers, switchyard, metering and indication instruments, equipment for carrier current, surge protection and outgoing feeders, as may be needed.
- Battery Energy Storage System (BESS) and Sasol Substation will have a combined footprint of up to 4 ha. The BESS storage capacity will be up to 300MW/1 200 megawatt-hour (MWh) with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology however the specific technology will only be determined following Engineering, Procurement, and Construction (EPC) procurement. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers. The BESS components will arrive on site pre-assembled;
- The control building, telecommunication infrastructure, oil dam(s) etc,
- All the access road infrastructure to and within the substation
- Associated infrastructure including but not limited to lighting, fencing, and buildings required for operation (ablutions, office, workshop and control room, security fencing and gating, parking area and storerooms).

4.3.1 COMPONENTS OF THE TRANSMISSION LINE

A brief overview of the physical/technical requirements of the project is as follows:

- 1 x up to 132kV OHPL (either single or double circuit) between the Alternative 1 substation (preferred Mukondeleli WEF onsite substation) and private offtaker substation at Sasol Secunda;
- Straight line distance between Alternative 1 substation (preferred Mukondeleli WEF substation) and private offtaker substation at Sasol Secunda is approximately 7.78 km;
- The assessment corridor for 1x up to 132kVA OHPL is 250 m to allow for micro-siting.
- The maximum height for an up to 132kV OHPL structure is approximately 40m.
- Minimum conductor clearance is between 8.1 and 12.6m.
- Span length between pylon structures is typically up to 250m apart, depending on complexity and slope of terrain.
- The design of 132kV structure is currently unknown, the following options will be used to determine preferred design:
  - Intermediate self-supporting monopole
  - Inline or angle-strain self-supporting monopole
  - Suspension self-supporting monopole
  - Triple pole structure
  - Steel lattice structure
- The up to 132 kV structures will have a concrete foundation and the sizes may vary depending on design type up to 80m^2 (10m by 8m), with depths reaching up to 3.5m typically in a rectangular 'pad' shape. The actual number of structures required will vary according to the final route alignment determined.

4.3.2 CLEARANCE REQUIREMENTS FOR TRANSMISSION LINES

For safety reasons, transmission lines require certain minimum clearance distances. These are as follows:

- The minimum vertical clearance distance between the ground and the transmission line is 6.7m.
- The minimum vertical clearance to any fixed structure that does not form part of the OHPL is 9.4m - 11m.
- The minimum distance between a 132kV OHPL and an existing road is 60m – 120m (depending on the type of road).
- Any farming activity can be practiced under the conductors provided that safe working clearances and building restrictions are adhered to.
- Minimum servitude to other parallel lines.

4.3.3 PROPOSED ASSOCIATED INFRASTRUCTURE

The proposed Grid Connection project will require the following with respect to the permanent infrastructure:

- Where the OHPL crosses a fence between neighbouring landowners and there is no suitable gate in place, a suitable gate will be erected in consultation with the landowner. These gates are necessary in order to ensure access to the line for maintenance and repair purposes.
- Existing road infrastructure will be used as far as possible to provide access for construction vehicles during the construction of the line. Thereafter, the roads are used for inspection and maintenance purposes. Where appropriate roads may be upgraded to access transmission lines and substations. Where no roads exist, access roads may be created for maintenance and inspection purposes.
- Fibre Optic cable could be strung on the earth cable if required for telecommunication
- Associated infrastructure including but not limited to lighting, fencing, and buildings required for operation (ablutions, office, workshop and control room, security fencing and gating, parking area and storerooms).

PROPOSED SWITCHING SUBSTATIONS

Two alternative substation locations have been proposed for the Mukondeleli WEF (Preferred Alternative 1 and Alternative 2). It must be indicated that both substation alternatives are planned to be constructed on approximately 10 ha. Based on the plan, an IPP substation and a Switching substation will be constructed for each of the alternatives. The substations will be constructed next to each other on areas of 2ha each. Electricity generated from the Mukondeleli WEF will be distributed through the IPP substation to the Switching substation, from the Switching substation electricity will be distributed by the proposed up to 132kV grid connection transmission line into the ECSS before being distributed to the national grid via a up to 400kV grid connection transmission line through Mukondeleli Power station. A 200m buffer has been included around the substations to allow for micrositing.

The substation will consist of a high voltage substation yard to allow for multiple up to 132kV feeder bays and transformers, control building telecommunication, and other substation components as required. Supporting infrastructure such as Control room, parking, oil spillage containment dam, fence, and other infrastructure will be constructed as part of the Eskom section substation (**Figure 4-3**).

There is a potential that the electricity generated will only feed into Sasol and not to the national electricity grid , in which instance the substations will be privately owned and managed and not transferred to Eskom.

Figure 4-3: Example of substation

4.4 PROPOSED PROJECT DEVELOPMENT ACTIVITIES

- The typical steps involved in the construction and operation of a transmission line is summarised below:
- Planning Phase
  - Step 1: Surveying of the development area and negotiation with affected landowners; and
  - Step 2: Final design and micro-siting of the infrastructure based on geotechnical, topographical conditions and potential environmental sensitivities.
- Construction Phase
  - Step 3: Vegetation clearing;
  - Step 4: Assembly and erection of infrastructure on site;
  - Step 5: Stringing of conductors; and
  - Step 6: Rehabilitation of disturbed areas and protection of erosion sensitive areas.
- Operation Phase
  - Step 7: Continued maintenance during operation.

4.4.1 CONSTRUCTION PHASE

CONSTRUCTION SCHEDULE

Construction of the OHPL is anticipated to take 6 - 12 months.

SITE ESTABLISHMENT AND TRANSPORTATION OF MATERIALS AND EQUIPMENT TO SITE

The selected contractor will establish a temporary site camp including, but not be limited to, temporary offices, laydown areas for equipment and materials, storage facilities, ablutions, waste storage and handling area, and parking area. The location and extent of the Contractors camp, to be established within the Project, are undertaken as part of a different application and are not covered in the EMPr. It is anticipated that materials will be collected on a daily basis from the contractor laydown area for the construction activities along the servitude. This limits areas to be impacted for storage along the servitude as well as for security purposes when activities cease at the end of each day.

The required materials and equipment will be transported to the site via public roads and private farm roads/tracks along the proposed servitude, as far as possible. Large mobile plant including mechanical/hydraulic augers, mobile cranes, bucket trucks/cherry pickers will be used during installation of the OHPL.

Labour Requirements

During site preparation and installation of Project related infrastructure the selected Contractor, working on behalf of Mukondeleli WEF, is anticipated to require 20-30 people to undertake the required works. Approximately 5% of workers would be highly skilled, 15% medium skilled, and 80% low skilled.

VEGETATION CLEARING

Due to the nature of the vegetation within the Project area, which is predominantly sparse, low shrubs and grasses, limited vegetation clearing will be required. Clearing of vegetation will be limited to pylon areas to facilitate installation of each pylon and that required for the substation and associated infrastructure footprints. Clearing will be done in phases along the OHPL route as required prior to installation activities.

INSTALLATION OF OHPL

Standard OHPL installation methods will be employed, which entails the excavations for foundations, planting of tower (concrete casting may be required) and stringing of the conductors.

A number of tower options could be utilised with a maximum height up to 30m above ground level, which are reported to have a life expectancy of more than 25 years. The actual height of the pylons will vary based on the site topography to maintain the specified clearance of the transmission lines.

Once the pylons have been installed, the lines will be strung. The Contractor will be responsible for functional testing and commissioning of the OHPL. This consists of connecting the line from the common collector substation to the Mukondeleli MTS.

ONSITE SUBSTATION

A new onsite substation will be established within the extent of the authorized Mukondeleli WEF. The Mukondeleli WEF IPP substation environmental authorisation is undertaken as part of a different process; however, the Offtaker Section Substation is part of this application. The Switching Substation will be constructed on an area of 2 ha. A second substation (and BESS) will be established at Sasol Secunda with a combined footprint of 4ha.

DEMOBILISATION

Upon completion of the installation phase, any temporary infrastructure will be removed, and the affected areas rehabilitated.

4.4.2 OPERATIONAL PHASE

Typically Eskom would be responsible for managing the operations of the OHPL in line with their internal management systems, however there is a potential that the electricity generated will only feed into Sasol and not to the national electricity grid, in which instance the substations will be privately owned and managed and not transferred to Eskom. The Offtaker is considered to have the requisite expertise to operate and maintain the transmission line. The Offtaker will adhere to all existing Safety Codes and Guidelines for the operation and maintenance of the OHPL infrastructure.

During the operational phase there will be little to no Project-related movement along the servitude as the only activities are limited to maintaining the servitude (including maintenance of access roads and cutting back or pruning of vegetation to ensure that vegetation does not affect the OHPL), inspection of the powerline infrastructure and repairs when required. Limited impact is expected during operation since there will not be any intrusive work done outside of maintenance in the event that major damage occurs to site infrastructure.

Operation of the OHPL will involve the following activities, discussed below.

SERVITUDE MANAGEMENT AND ACCESS ROAD MAINTENANCE

Servitude and access road maintenance is aimed at eliminating hazards and facilitating continued access to the OHPL. The objective is to prevent all forms of potential interruption of power supply due to overly tall vegetation/climbing plants or establishment of illegal structures within the right servitude. It is also to facilitate ease of access for maintenance activities on the OHPL. During the operational phase of the project, the servitude will be maintained to ensure that the OHPL functions optimally and does not compromise the safety of persons within the vicinity of the OHPL.

TRANSMISSION LINE MAINTENANCE AND OPERATIONS

The Offtaker will develop comprehensive planned and emergency programmes through its technical operations during the operation and maintenance phase for the OHPL. The maintenance activities will include:

— The Offtaker's Maintenance Team will carry out periodic physical examination of the OHPL and its safety, security and integrity.
— Defects that are identified will be reported for repair. Such defects may include defective conductors, flashed over insulators, defective dampers, vandalised components, amongst others.
— Maintenance / repairs will then be undertaken.

4.4.3 DECOMMISSIONING PHASE

Decommissioning will be considered when the OHPL is regarded obsolete and will be subject to a separate authorisation and impact assessment process. This is not expected to occur in the near future.

4.5 NEED AND DESIRABILITY OF THE PROJECT

The DEA&DP Guideline (2013) states that the essential aim of need and desirability is to determine the suitability (i.e. is the activity proposed in the right location for the suggested land-use/activity) and timing (i.e. is it the right time to develop a given activity) of the development. Therefore, need and desirability addresses whether the development is being proposed at the right time and in the right place. Similarly, the 'Best Practicable Environmental Option' (BPEO) as defined in NEMA is "*the option that provides the most benefit and causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term*."

The development of renewable energy and the associated energy infrastructure is strongly supported at a national, provincial, and local level. The development of, and investment in, renewable energy and associated energy distribution infrastructure is supported by the National Development Plan, New Growth Path Framework and National Infrastructure Plan, which all highlight the importance of energy security and investment in energy infrastructure. The development of the proposed power line is therefore supported by key policy and planning documents and is in line with South Africa's strategic energy planning context (Refer to **Section 2**).

Due to the fact that the Project will be providing energy to Sasol, the Project will also aid in the increase of exports from South Africa through the production of green hydrogen that has become popular globally. Hydrogen has become one of the latest buzzes for meeting the world's growing energy needs and a vital component for meeting the global decarbonization goals. Hydrogen is a clean fuel; however, the manufacturing of hydrogen fuel is energy-intensive and traditionally uses fossil fuels to power the production plant.

Sasol's intent is to lead the energy transition in South Africa. Sasol's goal is to reduce its greenhouse gas footprint for Scope 1 and 2 emissions by 30% by 2030 and achieve Net Zero by 2050. This will be achieved through a combination of energy and process efficiencies, strategic partnerships, investments in renewables and a shift to incremental natural gas as a transition feedstock and ultimately green hydrogen and sustainable carbon for the Southern African value chain.

At the core of Sasol's renewable energy strategy is the development of green hydrogen innovations. Green hydrogen is recognised as a key enabler to decarbonisation because of its ability to decarbonise hard-to-abate industries such as aviation, steel and heavy-duty mobility.

The energy security benefits associated with the proposed Mukondeleli WEF is dependent upon it being able to connect to the national grid via the establishment of grid connection infrastructure. The proposed OHPL is therefore essential supporting infrastructure to the WEF development, which, once developed, will generate power from renewable energy resources.

No physical or economic displacement will be required along the proposed route.

Furthermore, negative environmental impacts associated with the activity will be mitigated to acceptable levels in accordance with the EMPr (**Appendix D**). Refer to **Section 7** below for the Environmental Impact Assessment and recommended mitigation measures.

5 PROJECT ALTERNATIVES

In terms of the EIA Regulations, feasible alternatives are required to be considered. All identified, feasible alternatives are required to be evaluated in terms of social, biophysical, economic, and technical factors. A key challenge of the BA Process is the consideration of alternatives. Most guidelines use terms such as ‘reasonable’, ‘practicable’, ‘feasible’ or ‘viable’ to define the range of alternatives that should be considered.

Effectively there are two types of alternatives:

— Incrementally different (modifications) alternatives to the project; and
— Fundamentally (totally) different alternatives to the project.

“Alternatives”, in relation to a proposed activity, means different ways of meeting the general purpose and requirements of the activity, which may include alternatives to –

a) the property on which or location where it is proposed to undertake the activity;
b) the type of activity to be undertaken;
c) the design or layout of the activity;
d) the technology to be used in the activity;
e) the operational aspects of the activity; and
f) the option of not implementing the activity (i.e. no-go).

All alternatives outlined below are considered both feasible and reasonable with no apparent advantages or disadvantages. .

5.1 ACTIVITY ALTERNATIVE

Only one activity has been assessed (i.e. an overhead powerline and substation). Alternative activities for the current Project are not reasonable or feasible as the purpose of this project is to transmit electrical energy generated by the proposed Mukondeleli WEF to the Mukondeleli onsite substation for distribution to a private offtaker substation to be located within the Sasol Secunda Primary Area.

5.2 TECHNOLOGY ALTERNATIVES

5.2.1 GRID CONNECTION

There are two methods of power transmission, these being overhead lines and underground cables. Underground cables are considerably more difficult and expensive to install and maintain, relative to overhead lines. Considering the proposed terrain of the proposed OHPL, which traverses several delineated wetlands and CBA 1 areas, underground cables would require extensive trenching which would result in greater environmental impacts. Underground powerlines are therefore not considered feasible for the proposed Project.

Therefore, only one technology has been assessed, namely distribution of electricity via a 132 kV OHPL and onsite 33/132kV substation, as this is considered the most appropriate technology and is in line with Eskom design requirements.

Two types of tower structures have been considered for the OHPL, monopole towers or steel lattice towers, which have been detailed below.

MONOPOLE-TYPE TOWERS

The type of tower to be used depends on the topography and the alignment of the powerline corridors. In general, monopole-type towers are used for transmission lines with shorter spans.

132KV INTERMEDIATE SELF-SUPPORTING DOUBLE CIRCUIT MONOPOLE (PREFERRED)

Self-supporting galvanised steel Monopole Intermediate or Suspension structure with no stays/anchors. The monopole is designed to support a double electrical circuit with a twin conductor arrangement. The monopole height varies between 26 m and 32 m (**Figure 5-1**).

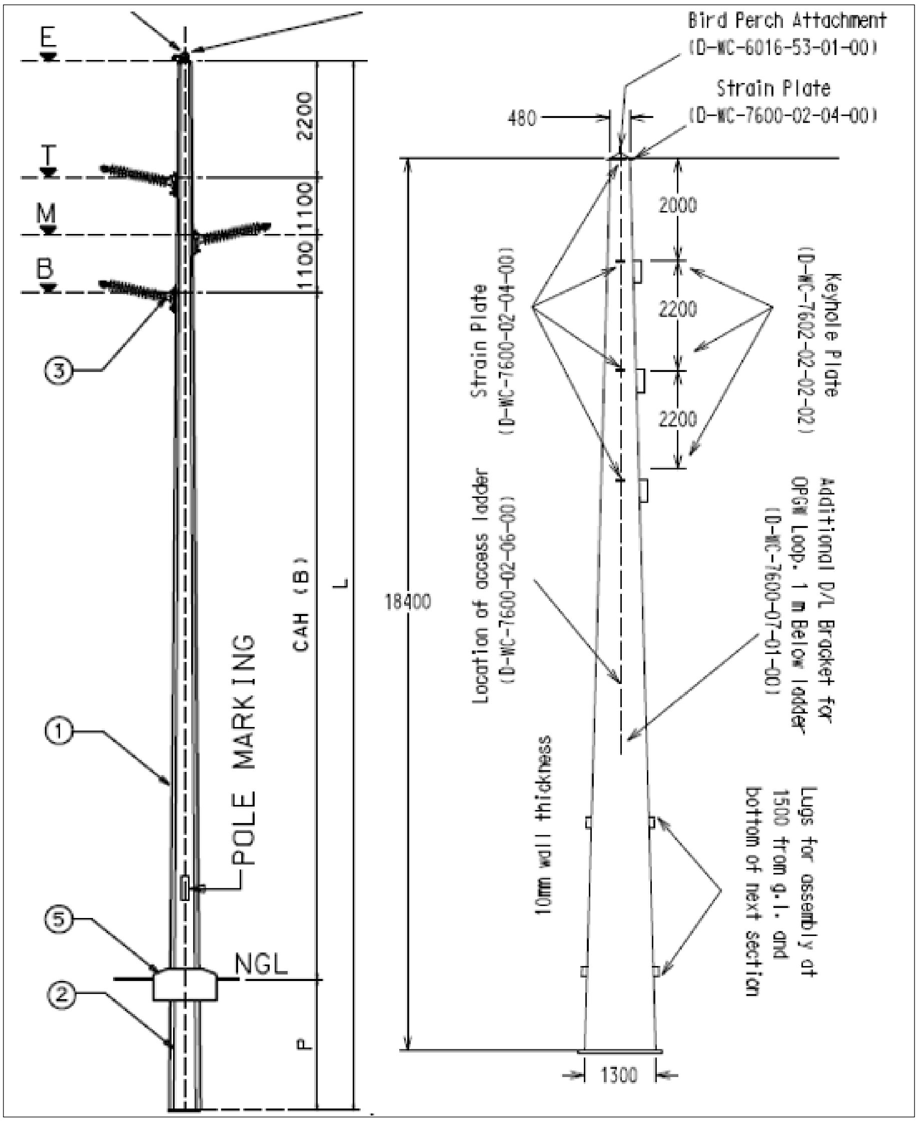


Figure 5-1: 132kV Intermediate Self-Supporting Double Circuit Monopole

132KV INLINE OR ANGLE STRAIN SELF-SUPPORTING DOUBLE CIRCUIT MONOPOLE.

Self-supporting galvanised steel Monopole inline or Angle Strain structure with no stays/anchors. The monopole is designed to support a double electrical circuit with a twin conductor arrangement (**Figure 5-2**),

This structure will be used as the strain structure and will be positioned at the angle points along the line or as an inline position where a strain point is required due to the ground elevation. The monopole height varies between 26 m and 32 m.

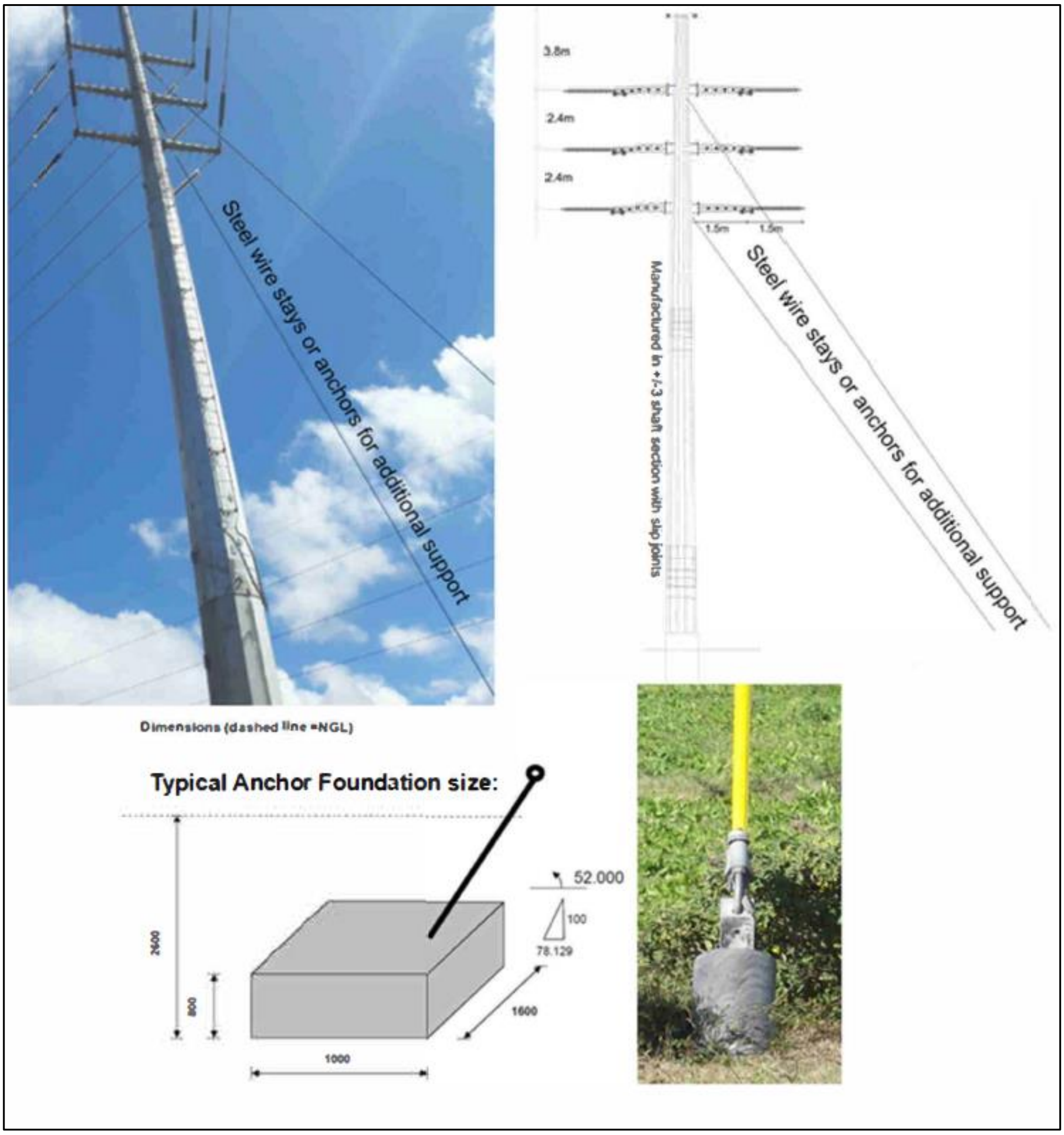


Figure 5-2: 132kV Inline Or Angle Strain Self-Supporting Double Circuit Monopole

132KV SUSPENSION SELF-SUPPORTING SINGLE CIRCUIT MONOPOLE WITH SINGLE CONDUCTOR

Self-supporting galvanised steel Monopole Suspension structure with no stays/anchors. The monopole is designed to support a single electrical circuit with a single conductor arrangement. The monopole height varies between 22m and 26m (**Figure 5-3**).

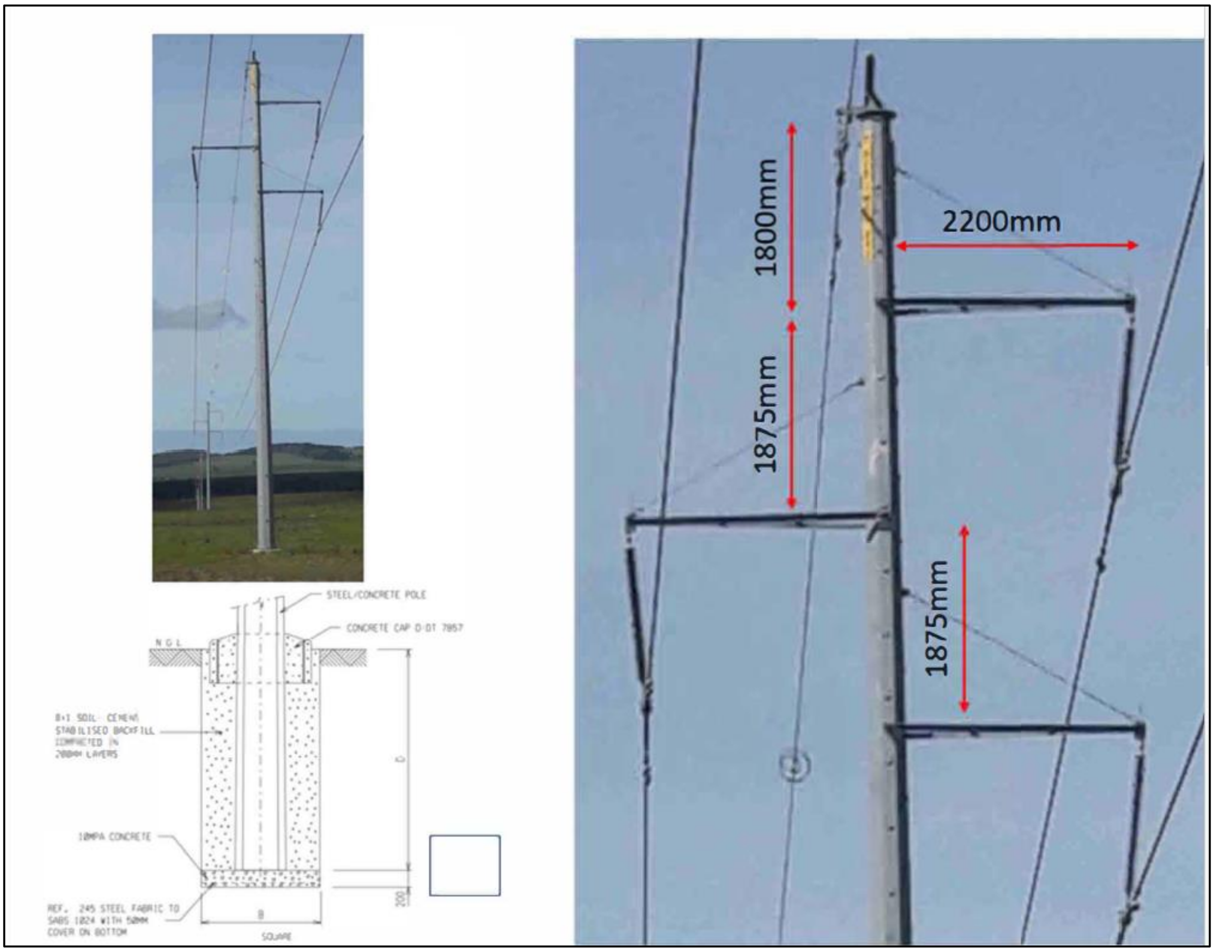


Figure 5-3: 132kV Suspension Self-Supporting Single Circuit Monopole With Single Conductor

132KV INLINE OR ANGLE STRAIN SELF-SUPPORTING SINGLE CIRCUIT MONOPOLE WITH SINGLE CONDUCTOR

Self-supporting galvanised steel Monopole Inline or Angle Strain structure with no stays/anchors. The monopole is designed to support a single electrical circuit with a single conductor arrangement. The monopole height varies between 24 m and 26 m. The foundation will consist of a typical pad foundation with bolts inside the concrete foundation (**Figure 5-4**).

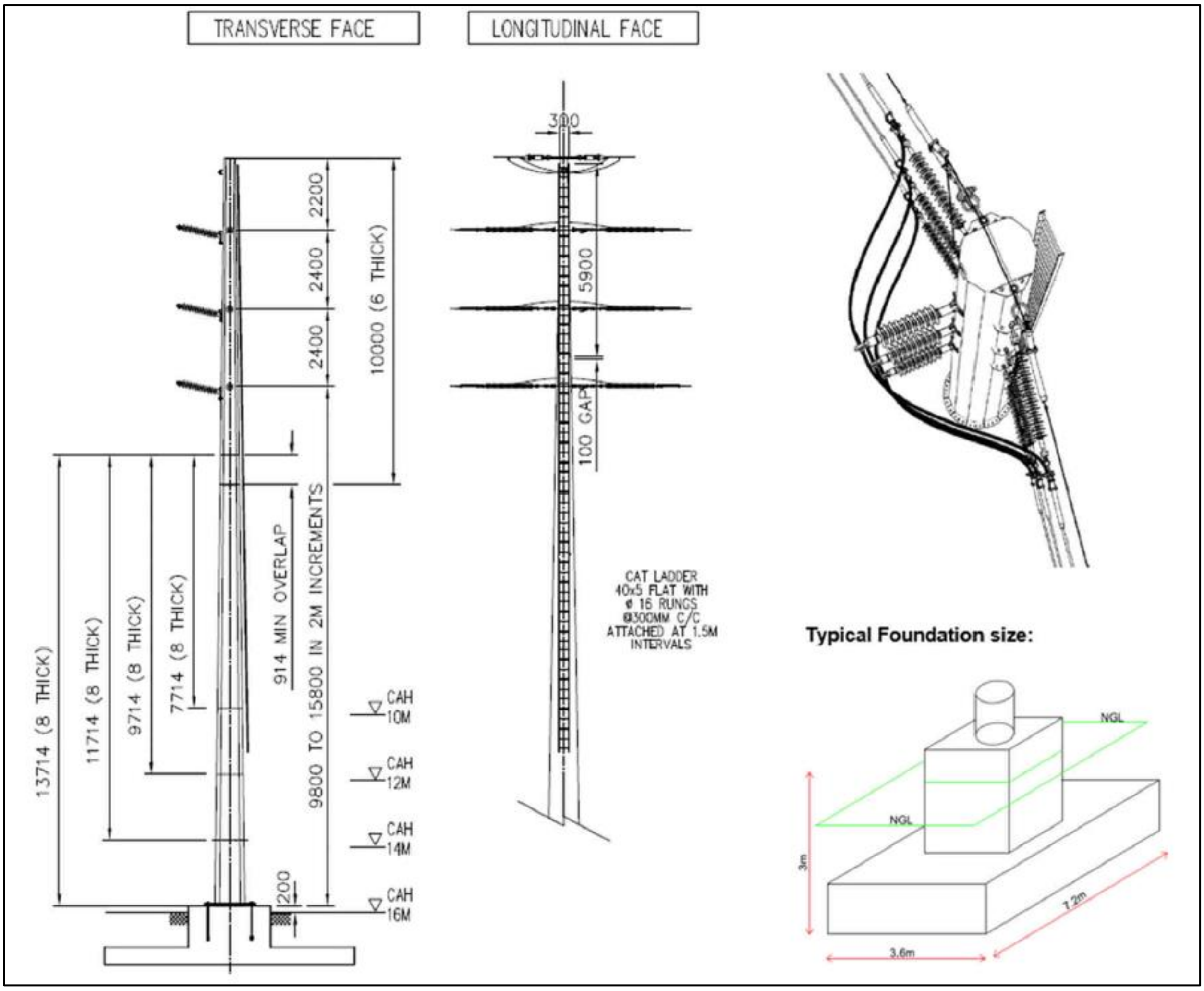


Figure 5-4: 132kV Inline Or Angle Strain Self-Supporting Single Circuit Monopole With Single Conductor

STEEL LATTICE TOWERS

Steel lattice-type pylons are only used where long spans (>500m) across valleys and rivers are required.

132KV/275KV POWERLINE DOUBLE CIRCUIT SUSPENSION TOWERS

Consist of a steel framework of individual structural components that are bolted or welded together. Can be designed to carry either one or two electrical circuits, referred to as single-circuit and double-circuit structures. The lattice pylons height varies between 25 m and 40 m (**Figure 5-5**).

Figure 5-5: 132KV/275KV Powerline Double Circuit Suspension Towers

FOUNDATIONS

The type of foundation required for each pylon is dependent on the geo-technical conditions. Foundations may be drilled, mechanically excavated, or dug by hand. All foundations are backfilled and stabilised through compaction and capped with concrete at ground level. Below are two examples of monopole foundations for different soil conditions (**Figure 5-6**).

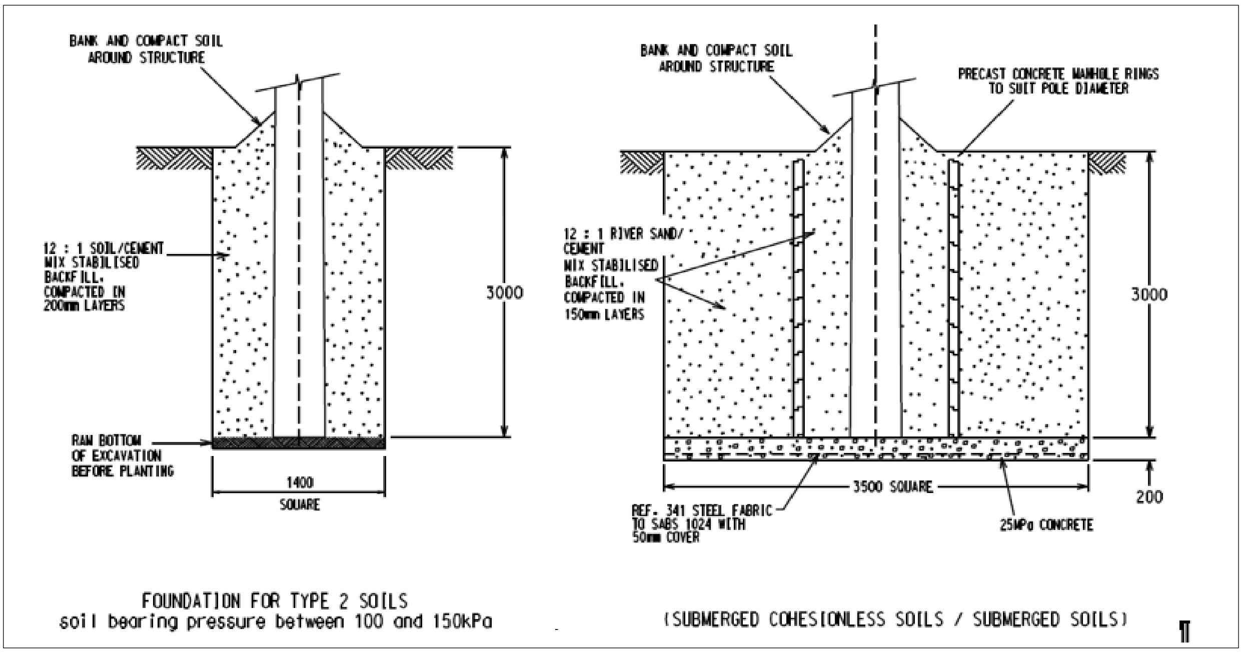


Figure 5-6: 132kV Power Foundations

5.2.2 BESS

The Proponent is considering two types of preferred battery technologies for the BESS, that is, either Solid State Lithium (SSL) or Vanadium Redox Flow (VRF) Battery Energy Storage Systems.

LITHIUM SOLID STATE BATTERIES

Solid-State Battery consists of multiple battery cells that are assembled together to form modules. Each cell contains a positive electrode, a negative electrode and an electrolyte. The BESS will comprise of multiple battery units or modules housed in shipping containers and/or an applicable housing structure which is delivered pre-assembled to the project site. Containers are usually raised slightly off the ground and layout out is rows. They can be stacked if required although this may increase the risk of events in one container spreading to another container. Supplementary infrastructure and equipment may include substations, power cables, transformers, power converters, substation buildings & offices, HV/MV switch gear, inverters and temperature control equipment that may be positioned between the battery containers. The solid-state batteries that are being considered are Lithium-ion systems.

In Lithium battery technologies, energy storage and release is provided by the movement of lithium ions from the negative electrode to the positive electrode during discharge and back when charging. Solid-State lithium (SSL) batteries have become increasing popular due to their high energy density, low self-discharge and long lifetime and cycling performances.

VANADIUM REDOX FLOW BATTERY

The project will employ utility scale batteries. These energy storage systems can be supplied either as containerized units or as a fixed installation within a building etc. Due to the proposed size of the facility (300MW) it is currently envisioned to house the units within a large battery building.

All electrochemical energy storage systems convert electrical energy into chemical energy when charging, and the process is reversed when discharging. With conventional batteries, the conversion and storage take place in closed cells. With redox flow batteries, however, the conversion and storage of energy are separated. Redox flow batteries differ from conventional batteries in that the energy storage material is conveyed by an energy converter. This requires the energy storage material to be in a flowable form. In redox flow batteries, charging and discharging processes can take place in the same cell. Redox flow batteries thus have the distinguishing feature that energy and power can be scaled separately. The power determines the cell size, or the number of cells and the energy is determined by the amount of the energy storage medium. In theory, there is no limit to the amount of energy that can be produced and/or stored thereby allowing for scalability of these systems. VRF battery is considered to have a large cycle life, independent power and energy ratings, relatively poor round trip, moderate cost and no self-discharge.

Figure 5-7 shows the general operating principle of redox flow batteries. The energy conversion takes place in an electrochemical cell which is divided into two half cells. The half cells are separated from each other by an ion-permeable membrane or separator, so that the liquids of the half cells mix as little as possible. The separator ensures a charge balance between positive and negative half cells, ideally without the negative and positive.

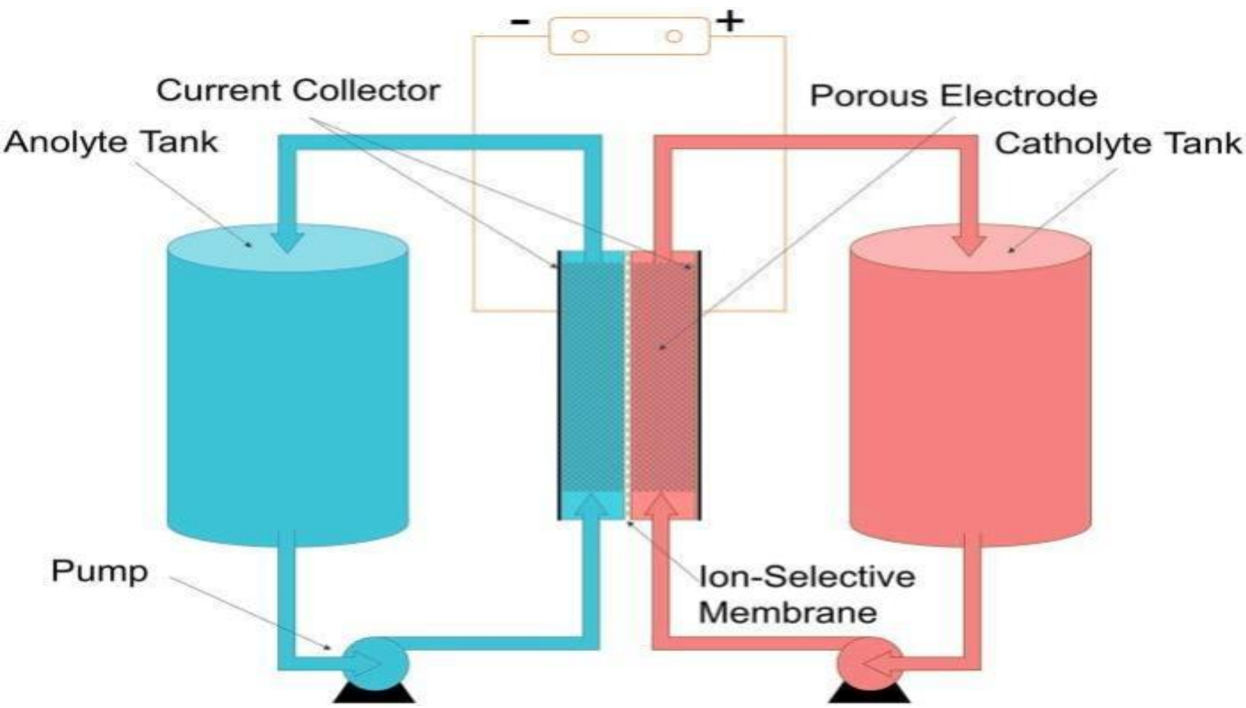


Figure 5-7: Schematic Diagrams of Redox Flow BESS Systems (Source: Wikipedia)

It is important to note that the selection of specific technology will only be determined following EPC, therefore both types of battery technologies have been considered in the BAR. The potential risks and impacts of the proposed BESS at the Sasol Substation have been assessed as part of this BAR and the Risk Assessment is included in **Appendix F-9**. Both options have been investigated in **Section 6.4** of this report and assessed in **Section 7.13**.

From a safety and health point of view, the risk assessment shows that risks posed by VRFB systems may be slightly lower than those of SSL facilities, particularly with respect to fire and explosion risks. From an environmental spill and pollution point of view the VRFB systems present higher short-term risks than the SSL systems. However, the above conclusions may be due to the fact that the VRFB technology is not as mature as SSL technology and therefore there is not as much operating experience and accident information available for the VRFB.

From a SHE risks assessment point of view, where there is a choice of location that is further from public roads, water courses or isolated farmhouses, this would be preferred. VRFB hazards are mostly related to possible loss of containment of electrolyte and SSL batteries to fires producing toxic smoke and fire fighting which may result in contaminated of firewater runoff. One would not want these liquids to enter water courses nor the smoke to pass close to houses / public traffic.

From a SHE perspective no fatal flaws were found with the proposed VRFB or Lithium Solid-state BESS installations. The preferred technology, from a technical and financial perspective, is Lithium battery technologies (Solid State Lithium (SSL)), however both SSL and the redox flow batteries are considered reasonable and feasible.

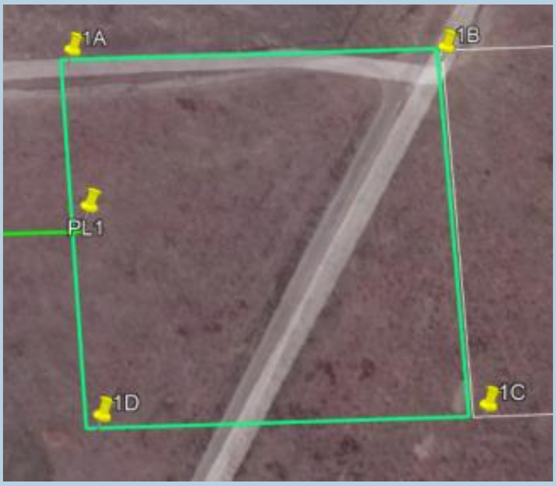
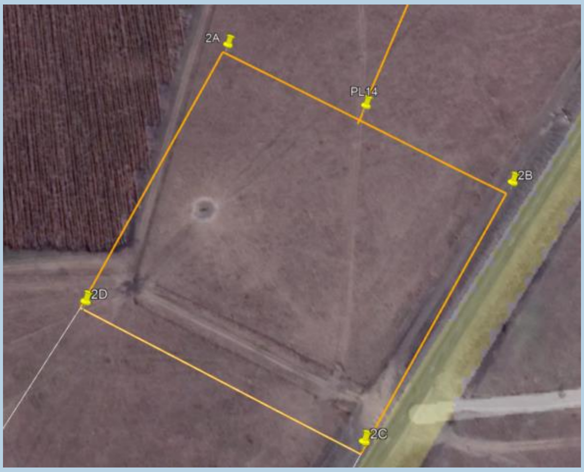
Both BESS technologies were assessed, and no fatal flaws were identified, therefore it is recommended that both alternatives be authorised. However, the SSL technology is preferred.

5.3 LOCATION ALTERNATIVES

The purpose of the OHPL and onsite substation is to connect the proposed Mukondeleli WEF to a private off taker (i.e. Sasol Secunda). Therefore, the OHPL is required to be located between the proposed Mukondeleli WEF onsite substation and the proposed Sasol Substation to be located within the Sasol Secunda Primary Area. The Sasol substation and BESS have a combined 255m x 150m (4ha) footprint. No alternative location for the proposed Sasol Substation is deemed viable.

Two alternative locations for the 33/132kV switching substation at the Mukondeleli WEF have been assessed as part of this BAR, each with a 135m x 150m (2 ha) footprint. These alternatives are depicted in **Figure 4-1. Table 5-1** outlines the corner co-ordinates of the substation alternative sites.

Table 5-1: Substation Alternative co-ordinates

POINT	LATITUDE	LONGITUDE
Mukondeleli Substation - Option 1 (Preferred)		
		
1A	26°36'57.14"S	29°11'19.43"E
1B	26°36'57.25"S	29°11'24.54"E
1C	26°37'1.97"S	29°11'24.72"E
1D	26°37'1.96"S	29°11'19.81"E
Mukondeleli Substation - Option 2		
		
2A	26°37'21.09"S	29°11'3.09"E
2B	26°37'23.59"S	29°11'7.77"E
2C	26°37'27.48"S	29°11'5.28"E
2D	26°37'25.37"S	29°11'1.05"E
Sasol Substation (including BESS)		

POINT	LATITUDE	LONGITUDE
		
SA	26°33'45.12"S	29° 9'38.16"E
SB	26°33'46.28"S	29° 9'47.44"E
SC	26°33'51.36"S	29° 9'46.68"E
SD	26°33'50.22"S	29° 9'37.77"E

5.4 LAYOUT ALTERNATIVES

As mentioned before, two (2) alternatives have been developed for the proposed project.

Due to undermining presented in the study area, it must be noted that the OHPL route alternatives follow the same routing from their point of convergence on the Farm Bosjesspruit 291 Portion 10 to the proposed Sasol Substation situated within the Sasol Secunda Primary Area.

These alternatives, as depicted in **Figure 4-1**, are described below:

— **OHPL Route Option 1:** approximately 7.7 km in length in its entirety from Substation Option 1 to the Sasol Substation;

— **OHPL Route Option 2:** approximately 8 km in length in its entirety from Substation Option 2 to the Sasol Substation;

A 250m corridor along the powerline (125m either side of centreline) as well as a 250m buffer around the substation has been assessed as part of this BAR. The co-ordinates for the bend points of each of the above alternatives are included in

Table 5-2.

Table 5-2: Bend point co-ordinates for the Alternative Powerline Routes

BEND POINT	CO-ORDINATES	
OHPL Option 1 (Preferred)		
PL1	26°36'59.30"S	29°11'19.65"E
PL2	26°36'59.45"S	29°11'17.47"E
PL3	26°36'53.07"S	29°11'13.45"E
PL4	26°36'55.29"S	29°10'59.40"E
PL5	26°36'48.48"S	29°10'55.54"E
PL6	26°35'59.63"S	29°10'41.18"E
PL7	26°35'7.14"S	29° 9'51.97"E
PL8	26°34'53.03"S	29° 9'56.25"E
PL9	26°34'45.15"S	29° 9'52.44"E
PL10	26°34'41.96"S	29° 9'30.17"E
PL11	26°34'17.65"S	29° 9'25.50"E
PL12	26°33'53.46"S	29° 9'29.04"E
PL13	26°33'50.44"S	29° 9'40.92"E
OHPL Option 2		
PL14	26°37'22.23"S	29°11'5.42"E

BEND POINT	CO-ORDINATES	
PL15	26°37'13.54"S	29°11'9.24"E
PL4	26°36'55.29"S	29°10'59.40"E
PL5	26°36'48.48"S	29°10'55.54"E
PL6	26°35'59.63"S	29°10'41.18"E
PL7	26°35'7.14"S	29° 9'51.97"E
PL8	26°34'53.03"S	29° 9'56.25"E
PL9	26°34'45.15"S	29° 9'52.44"E
PL10	26°34'41.96"S	29° 9'30.17"E
PL11	26°34'17.65"S	29° 9'25.50"E
PL12	26°33'53.46"S	29° 9'29.04"E
PL13	26°33'50.44"S	29° 9'40.92"E

5.5 'NO PROJECT' ALTERNATIVE

In the "no project" alternative, the Mukondeleli 132kV Grid Connection project will not be developed. In this scenario, there could be a missed opportunity to address the need for increase in renewable energy generation in an effort to mitigate against concerns of climate change and exploitation of non-renewable resources.

The no-go alternative would also not assist Sasol's intent to lead the energy transition in South Africa. Sasol's goal is to reduce its greenhouse gas footprint for Scope 1 and 2 emissions by 30% by 2030 and achieve Net Zero by 2050. This will be achieved through a combination of energy and process efficiencies, strategic partnerships, investments in renewables and a shift to incremental natural gas as a transition feedstock and ultimately green hydrogen and sustainable carbon for the Southern African value chain.

At the core of Sasol's renewable energy strategy is the development of green hydrogen innovations. Green hydrogen is recognised as a key enabler to decarbonisation because of its ability to decarbonise hard-to-abate industries such as aviation, steel and heavy-duty mobility.

Conversely, negative environmental impacts of the project (as outlined in **Section 7**) associated with the development of the Mukondeleli 132kV Grid Connection would be avoided.

The "no project" alternative has been considered in this BAR as a baseline against which the impacts of the Mukondeleli 132kV Grid Connection project have been assessed

6 BASELINE ENVIRONMENT

The following chapter presents an overview of the biophysical and socio-economic environment in which the proposed Project is located. It is important to gain an understanding of the Project area and its surroundings, as it will provide for a better understanding of the receiving environment in which the Project is being considered.

The description of the baseline environment is essential in that it represents the conditions of the environment before the construction of the proposed Project (i.e. the current, or status quo, environment) against which environmental impacts of the proposed Project can be assessed and future changes monitored.

The following characteristics of the receiving environment for the proposed Project area are described in **Table 6-1** below.

Table 6-1: Characteristics of the receiving environment

RECEIVING ENVIRONMENT	CHARACTERISTICS	
Physical Environment	— Climate — Topography — Geology — Soils and Agriculture — Surface Water	This information was extracted from the following studies: — Visual Impact Assessment (**Appendix F-7**) — Desktop Geotechnical Assessment (**Appendix F-10**) — Agricultural Assessment (**Appendix F-8**) — Aquatic Impact Assessment (**Appendix F-6**)
Biological Environment	— Vegetation — Conservation Plans — Protected Areas — Plant Species — Fauna Specialist — Avifauna	This information was extracted from the following studies: — Terrestrial Ecology Impact Assessment (**Appendix F-2**) — Avifauna Impact Assessment (**Appendix F-1**)
Social and Economic	— Land use — Heritage — Palaeontology — Landscape and Visual — Socio-Economic	This information was extracted from the following studies: — Visual Impact Assessment (**Appendix F-7**) — Heritage Impact Assessment (**Appendix F-3**) — Palaeontological Impact Assessment (**Appendix F-4**) — Social Impact Assessment (**Appendix F-5**)
Health and Safety	— Vanadium Redox Flow Battery — Solid State Lithium Battery — Other Chemicals or Hazards	This information was extracted from the following studies: — Qualitative Risk Assessment (**Appendix F-9**)

6.1 PHYSICAL ENVIRONMENT

6.1.1 CLIMATE AND METEOROLOGY

REGIONAL CLIMATE (MUCINA & RUTHERFORD 2006)

The site falls in a strongly seasonal summer-rainfall, cool-temperate region, with very dry winters. The mean annual precipitation of the Soweto Highveld Grassland is 662 mm with a peak in rainfall from November to January. The annual precipitation coefficient of variation is 27%. Mean annual potential evaporation is 2060 mm, while the mean annual soil moisture stress is 75%. Mean annual temperature is 14.8°C and frost is frequent in winter with a mean of 41 days per annum.

RAINFALL

The mean annual rainfall in the region ranges from 667 mm at the farm Zandfontein to 738 mm at the farm Driefontein, both close to Secunda (**Table 6-2**). The mean annual rainfall as measured at Secunda is 693 mm (**Table 6-2, Table 6-3** and **Figure 6-1**). The total annual rainfall at Secunda during dry and wet years respectively may range from 558 mm to 965 mm, indicating a moderate variation in the annual rainfall. The rainy season at Secunda is predominantly from October to March when about 86% of the annual rainfall occurs. December and January are the wettest months and the driest period is from May to August, when less than 15 mm of rain per month is recorded. Maximum rainfall measured over a 24-hour period at Secunda was 82 mm, recorded in November. The highest monthly rainfall recorded was 241 mm, also measured in November.

Table 6-2: Rainfall at some weather stations in the environs of the Mukondeleli site (Weather Bureau, 1998).

	Mean Annual Rainfall (mm)				
Month	Secunda	Zandfontein	Driefontein	Bethal	Standerton
Jan	114	125	121	146	122
Feb	93	97	100	75	87
Mar	64	84	80	61	66
Apr	35	34	44	48	44
May	8	24	21	14	12
June	14	6	7	7	9
July	2	12	9	6	7
Aug	8	5	10	13	12
Sep	33	24	27	28	29
Oct	82	62	71	78	86
Nov	104	100	116	129	117
Dec	136	116	118	106	104
Year	693	667	738	711	695

Table 6-3: Maximum rainfall (mm) in 24 hours, highest maximum and lowest monthly minimum rainfall at Secunda: 26° 30' S; 29° 11' E; 1628 m (Weather Bureau, 1998).

	Rainfall (mm)			
Month	Mean (month)	24 h max	Max per month	Min per month
Jan	114	66	168	50
Feb	93	69	142	41
Mar	64	55	121	31
Apr	35	56	119	2
May	8	12	18	0
June	14	41	75	0
July	2	6	13	0
Aug	8	24	24	0
Sep	33	26	107	0
Oct	82	59	146	0
Nov	104	82	241	0
Dec	136	76	200	89
Year	693	82	965	558

TEMPERATURE

The mean annual temperature for Secunda is 15.8°C (**Table 6-4**) with the extreme maximum and minimum temperatures 33.0°C and -4.3°C respectively. The mean daily maximum for January is 27.2°C and for July it is 18.1°C, whereas the mean daily minimum for January is 13.5°C and for July it is 0.9°C.

Table 6-4: Temperature data (°C) for the Secunda region: 26° 30' S; 29° 11' E; 1628 m (Weather Bureau, 1998).

	Temperature (°C)												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Max	27.2	25.9	25.2	23.0	20.8	17.3	18.1	21.5	22.3	24.3	23.8	26.0	27.2
*Ext. Max	33.0	32.5	30.0	30.6	25.5	25.3	25.3	27.0	31.0	32.0	31.0	31.5	33.0
Min	13.5	12.9	12.0	9.8	5.9	2.3	0.9	4.1	6.9	10.0	11.1	13.6	0.9
*Ext. Min	10.1	10.5	7.1	4.2	2.0	-2.6	-4.3	-1.5	1.1	4.3	6.3	8.8	-4.3
Mean	20.4	19.3	18.6	16.3	13.4	9.8	9.5	12.8	14.6	17.1	17.5	19.9	15.8

— Max = mean daily maximum temperature for the month
  *Ext. Max = extreme maximum temperature recorded per month
— Min = mean daily minimum temperature for the month
  *Ext. Min = extreme minimum temperature recorded per month
— Mean = mean monthly temperature for each month and for the year

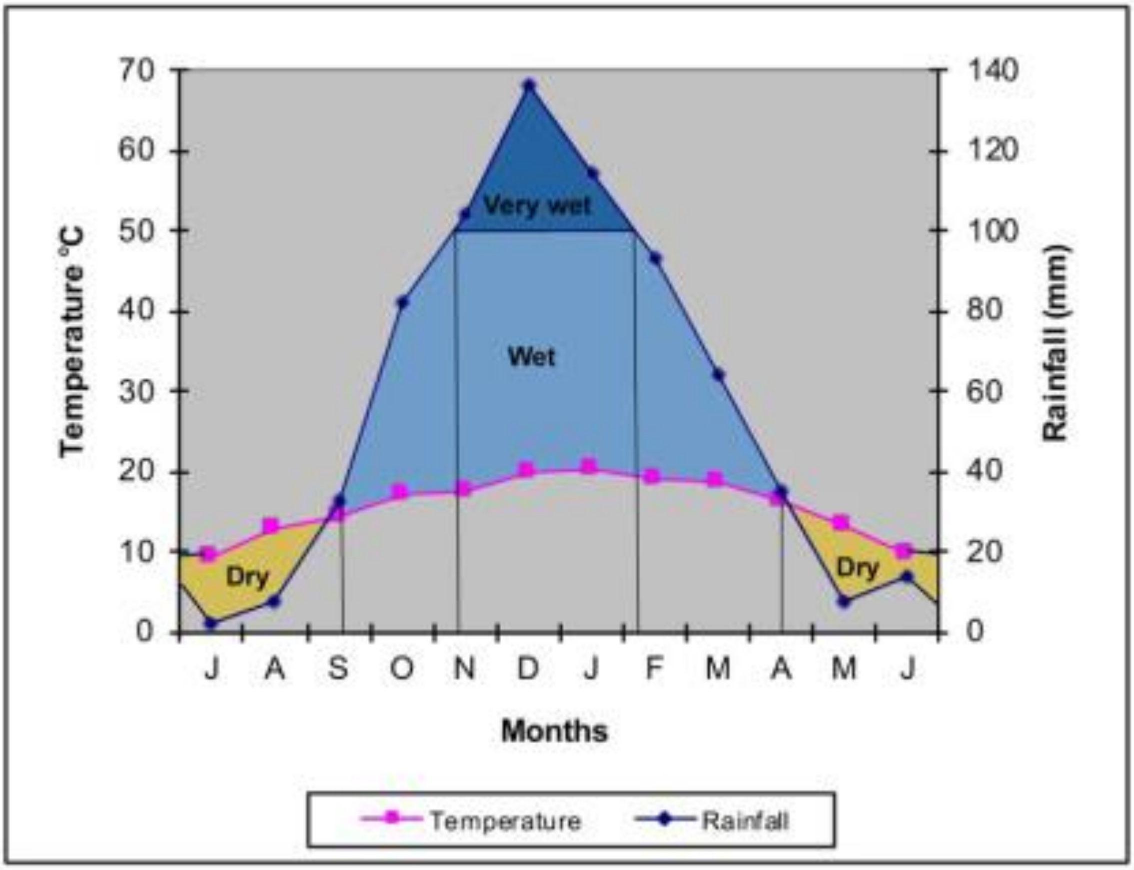


Figure 6-1: Climate diagram for the Secunda region. Months on X-axis are from July to June. When the rainfall curve is below the temperature curve, it indicates a dry period and when the monthly rainfall is higher than 100 mm it indicates a very wet period.

CLOUDINESS AND RELATIVE AIR HUMIDITY

At Bethal weather station, approximately 25 km east of Secunda, cloud cover at 14:00 is the highest from November to January (5.1 – 5.3 eights) and the lowest in June, July and August (1.5 – 1.9eights) (**Table 6-5**). The highest mean relative air humidity (%) at 08:00 occurs during the late summer and autumn months (February to April; 83 – 84%) and the lowest relative air humidity at 14:00 (31%) occurs in early spring (August) (Weather Bureau 1998).

Table 6-5: Cloud cover at 14:00 and percentage relative air humidity at 08:00 and 14:00 at Bethal: 26° 27' S; 29° 29' E; 1663 m (Weather Bureau, 1998)

	Cloud (0-8)	Relative air humidity %	
	14:00	08:00	14:00
Jan	5.2	80	51
Feb	4.9	83	48
Mar	4.9	83	44
Apr	4.1	84	41
May	2.4	80	34
June	1.6	81	34
July	1.5	79	33
Aug	1.9	75	31
Sept	3.1	74	33
Oct	4.6	75	41
Nov	5.3	77	49
Dec	5.1	77	48
Year	3.7	80	41

6.1.2 TOPOGRAPHY

The broader area surrounding the proposed Mukondeleli EGI is characterised by a mix of flat to undulating plains intersected by shallow river valleys. Areas of slightly higher elevation occur in the central and north-eastern sectors of the study area. Slopes across the study area are relatively gentle to moderate, with steeper slopes being largely associated with the more incised river valleys. The topography and slope characteristics of the study area are illustrated in **Figure 6-2**and **Figure 6-3** respectively.

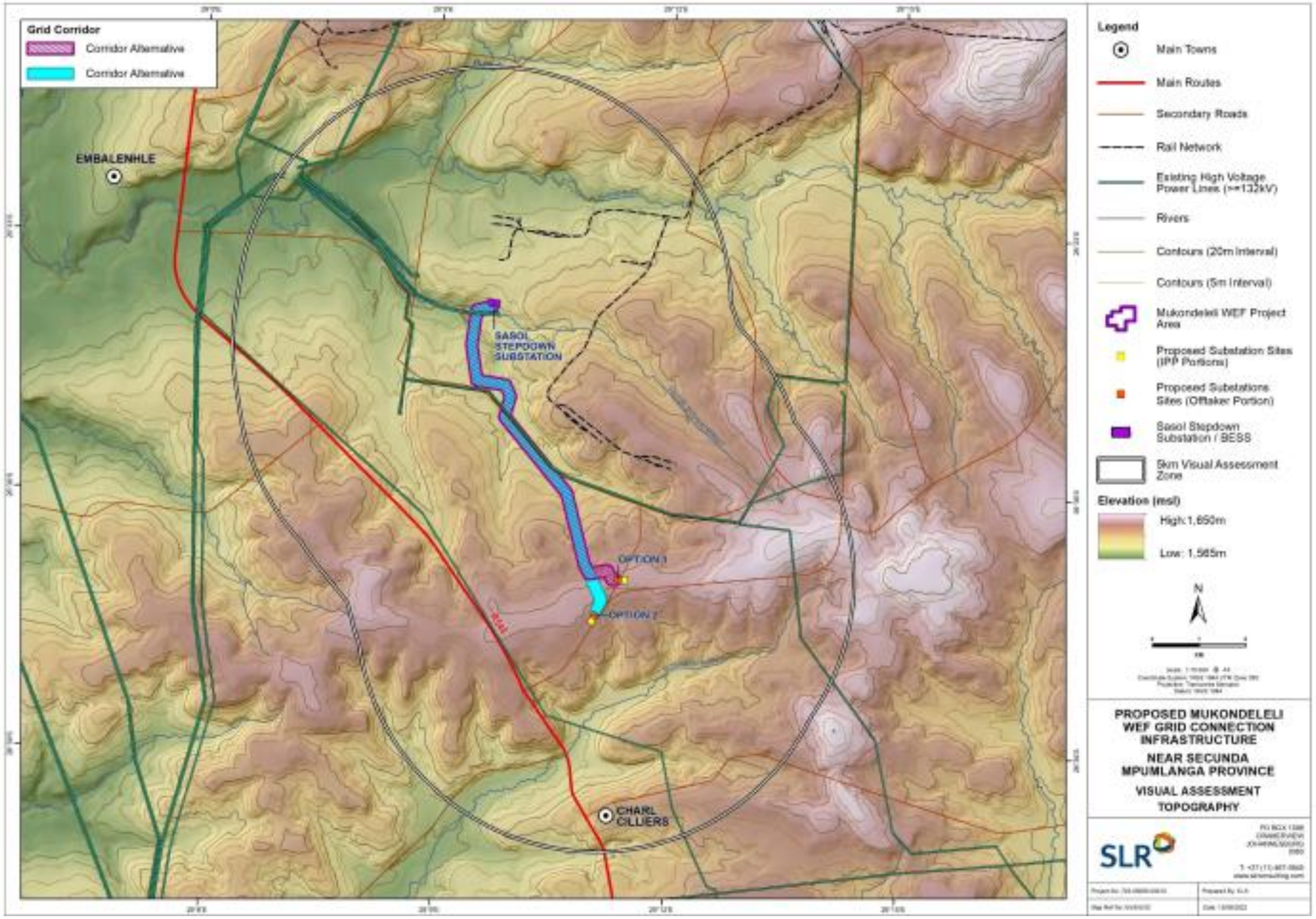


Figure 6-2: Topography at Mukondeleli Powerline Corridor

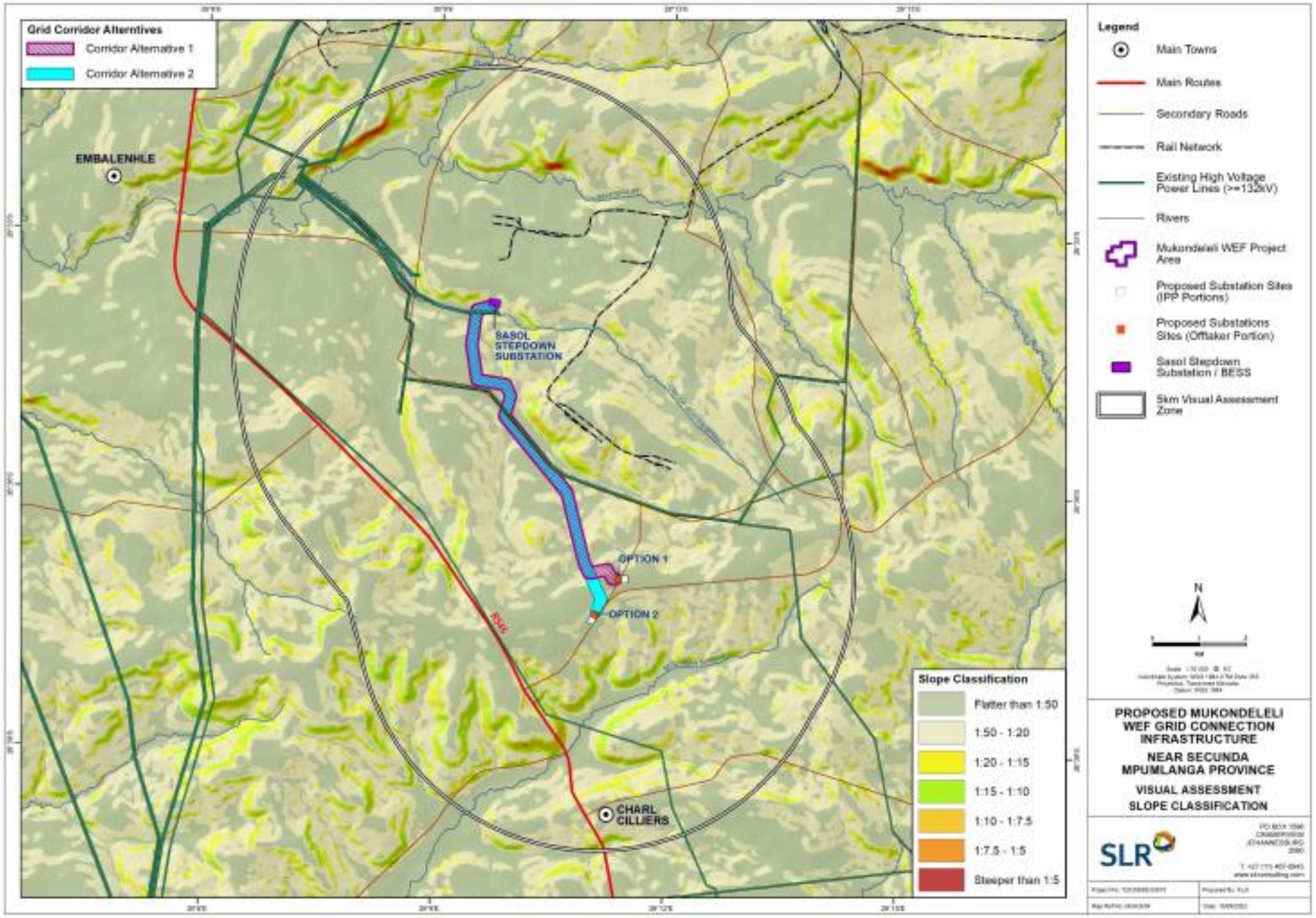


Figure 6-3: **Slope Classification of the Mukondeleli Powerline corridor**

6.1.3 GEOLOGY

According to the published 1: 250 000 geological map (Sheet 2628 East Rand), the study area is underlain by rocks of the Vryheid Formation (Pv), Ecca Group of the Karoo Supergroup. This Vryheid Formation comprises sandstone, shale and coal beds.

The Vryheid Formation has been extensively intruded by Jurassic age dolerite (Jd). The dolerites occur both as sills and linear dyke structures that may extend over tens of kilometers.

Significant recent surficial deposits, alluvium, blanket the areas along the drainage features in the southern portion of the site.

An excerpt of the published geological map showing the project areas is presented as **Figure 6-4** and the lithostratigraphy is presented as **Table 6-6**.

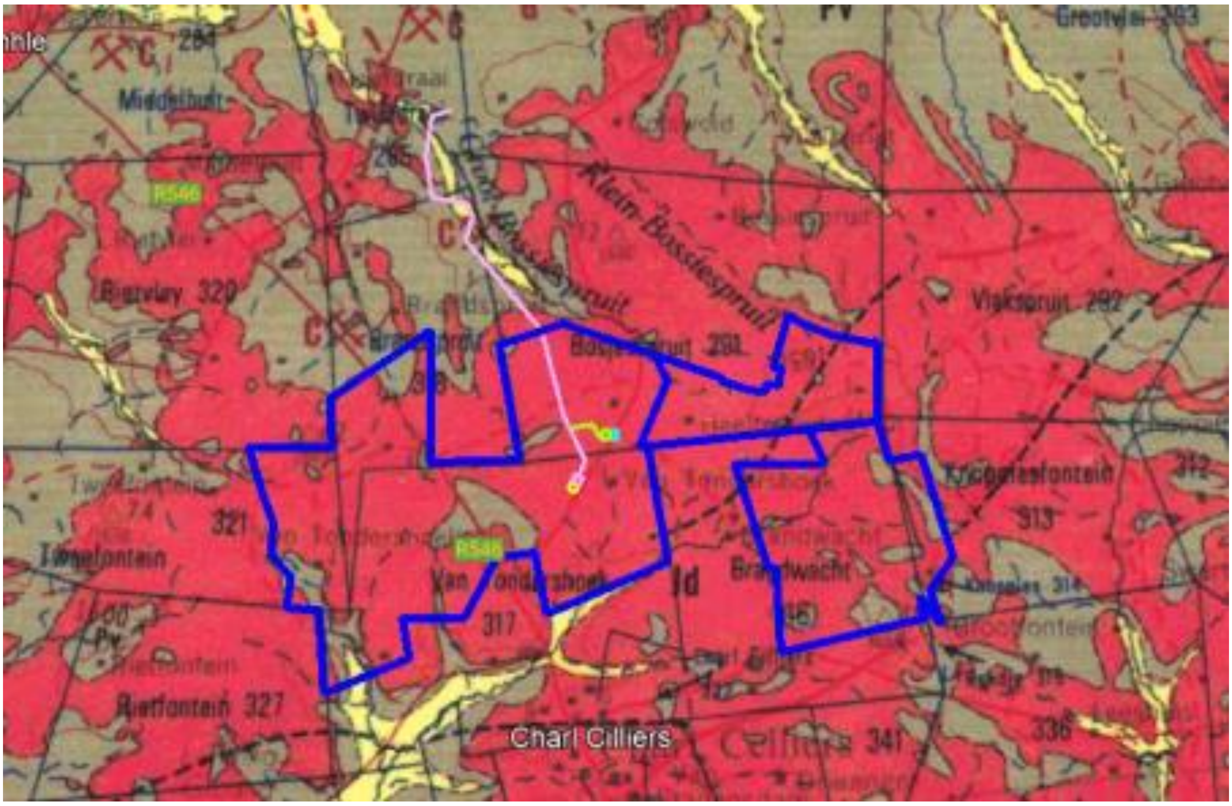


Figure 6-4: Geological map of the area around the Mukondeleli 132kV Grid Connection

Table 6-6: Lithostratigraphy of the Area

SUPERGROUP	GROUP	FORMATION	LITHOLOGY	MAP SYMBOL
			Alluvium	
			Dolerite	Jd

SUPERGROUP	GROUP	FORMATION	LITHOLOGY	MAP SYMBOL
Karoo	Ecca	Vryheid	Sandstone, shale, coal beds	Pv

ENGINEERING GEOLOGY

Engineering geology relates to the engineering characteristics of the natural earths material for founding structures and suitability for use as construction materials. The turbine positions are underlain by two different lithologies as listed in **Table 6-7**Table 6-7 below.

Table 6-7: Geological Formations Underlying the OHPL and Substations

	GRID AND ASSOCIATED INFRASTRUCTURE
Dolerite	3km of Option 1 Powerline 3km of Option 2 Powerline Mukondeleli Substation Option 1 Mukondeleli Substation Option 2
Vryheid Formation	5km of Option 1 Powerline 5km of Option 2 Powerline Sasol Substation

ALLUVIUM

Alluvium deposits result from the transportation and deposition of sediment by rivers. The deposits vary in relation to the geology of the catchment area, the site of deposition and the strength of the river. Engineering problems related to alluvial deposits include:-

— Sandy materials being potentially collapsible
— Clayey and silty materials being compressible in the long tern
— Clay material being potentially expansive

Alluvium is anticipated in the floodplains located along the powerline route and ponding of surface water is a common problem in such areas.

VRYHEID FORMATION

Shale

Vryheid shale generally weathers to a clayey residual soil which is often compressible and potentially expansive. Expansive soils are those materials that exhibit volume change with a change in moisture content. These materials “shrink” when the moisture content decreases and “heave” or “expand” when the moisture content increases. Where the residual clay profile is thinly developed, it is recommended that the material should be stripped. Where thickly developed, the structural design needs to take cognizance of the potential expansiveness and compressibility of this material.

The residual shale was profiled as slightly moist, firm to stiff, intact, sandy silty clay with occasional angular gravelly shale rock fragments. The residuum was encountered from a depth of between 0.70m and 0.80m and extended to below the excavation depth of 2.50m.

Shale rock and excavated shale, which presents as a gravel, often deteriorates on exposure. Although shale material can be considered for use in construction, the potential for deterioration needs to be pre-determined in the laboratory. If suitable, the gravel can be used in selected layers in road construction, but seldom as base course. Gravelly shales are occasionally used in the wearing course of gravel roads but not all types are suitable. During construction Karoo shales and siltstones can usually be excavated by ripping, but blasting might occasionally be required.

Slope instability may occur when sliding occurs on bedding planes which are inclined sufficiently. Ingress of water into layers and the resulting high pore-water pressure plays a major role in sliding failures. This is considered highly unlikely as the strata are mostly horizontally disposed.

Sandstone

Vryheid sandstone generally weathers into sandy residual soils. In some cases, the residual sandstone may develop a potentially collapsible grain structure. These collapsible materials exhibit additional settlement upon wetting up without any change in load. This can occur many years after construction and is usually due to an inundation of some kind such as a broken water pipe. If recognised at investigation stage, these collapsible materials can be easily dealt with during construction with some remediation being required.

Sands below the water table are likely to fail during the installation of augered piles and hence the pile system used should be carefully considered.

Residual sandstone does not weather uniformly, leading to dense layers of the horizon being underlain by less competent layers of the same soil.

Slope stability issues can arise in areas where closely intercalated sandstones and mudrock (shale and siltstone) exist. When shales and siltstones slake or disintegrate the exposed sandstone layers are undercut, this can result in rockfalls. Intercalated siltstone layers are relatively impermeable, and impede the flow of water, which leads to pore pressure build up and sliding along the interface. This can only happen if the rock is dipping at an angle, towards the slope face, greater than the friction angle of the material.

Where material is required for the construction of roads and laydown areas, natural sandstone gravel or crushed sandstone bedrock can potentially be a suitable source. Consideration must be given to the presence of excessive pyrite and muscovite which can cause distress where sandstone is used as basecourse. In addition, where chemical stabilization is required the clay matrix of sandstones make them suitable for stabilization with lime. The occurrence, nature, material quality and quantity of sandstone and other potential construction material will have to be assessed during the detailed geotechnical investigation.

Coals Beds

Coal seams are present within the Vryheid Formation with a thickness ranging from centimeters to 10m but are not generally encountered at surface. A number of mines are present in the area.

DOLERITE

Generally, dolerite weathers into a profile becoming coarser with depth eventually grading into dolerite rock. Cobbles and boulders are often present above the rock grading upwards into gravel, sand and finally residual clay. Cobbles and boulders of dolerite, however, are often present throughout the residual profile.

Residual doleritic clay is generally compressible and potentially expansive in the “medium to high” range. Where any structure straddles residual dolerite and a different soil type, the structure should be moved to avoid differential settlement or designed accordingly.

Residual dolerite encountered at relatively shallow depth across the study area was profiled as, slightly moist, medium dense to dense, clayey silty sand with abundant rounded to sub-rounded dolerite gravel, cobbles and boulders. The depth at which residual dolerite was encountered ranged from 0.10m to 0.30m and the horizon extended to a depth of between 0.60m to 2.70m. Refusal was mainly encountered in this horizon due to the presence of dolerite boulders.

Dolerite rock was profiled in some test pits at a depth of between 0.40m to 1.10m. Dolerite rock, cobbles, boulders, gravel and sand are generally durable and are suitable for a variety of purposes. It is commonly quarried and used as a construction material such as for aggregate and road construction.

6.1.4 SOILS AND AGRICULTURAL POTENTIAL

The entire site falls within the Ea17 land type. The geology is dolerite as well as sandstone, grit and shale of the Vryheid formation of the Ecca group. The soils are predominantly high clay content, dark coloured vertic and melanic soils, underlain by rock in upland positions and clay in bottomland positions. Soil forms are Arcadia, Rensburg, Valsrivier, Swartland, Mayo and Milkwood. The agricultural potential of the soils is limited variously by the very high clay content, shallow depth and drainage limitations.

The development is located in a grain farming agricultural region, but the soils vary in their suitability for crop production. Because of the favourable climate and the fairly high grain yields, farmers in the area utilise all suitable soil for grain production. Only soil that is not suitable for grain production is used for cattle and sheep grazing. Limitations that render the soil unsuitable for grain production are depth limitations due to rock or dense clay in the subsoil, and the limited drainage associated with the dense, poorly drained clay layers in the subsoil. The grazing lands are *rooigras* (*Themeda triandra*) grasslands. Grass fields are burned or mowed from time to time.

6.1.5 SURFACE WATER

Several wetlands and rivers are located on the study site and all drain into the Boesmanspruit River in the middle of the study site (**Figure 6-5**). The wetlands are divided into several types including:

— Seepage wetlands;
— Valley Bottom Wetlands; and

Only five wetlands were recorded within the study site. Wetlands 1-3 fall in catchment C12D and all form part of Grootbossiespruit system. Wetlands 4-5 fall in catchment C12E and drains south into the Boesmanspruit..

Buffer zones were calculated for the wetlands following Macfarlane *et al.*, (2015). Results for each wetland unit are as follows:

— Floodplain Wetland – 61 m
— Floodplain Wetland – 61 m
— Seepage Wetland – 61 m
— Valley Bottom Wetlands – 79m
— Seepage with Artificial Characteristics historical trenches – 42 m

Figure 6-6 shows the delineated watercourses relative to the study areas together with buffer zones and the 500m DWS regulated area.

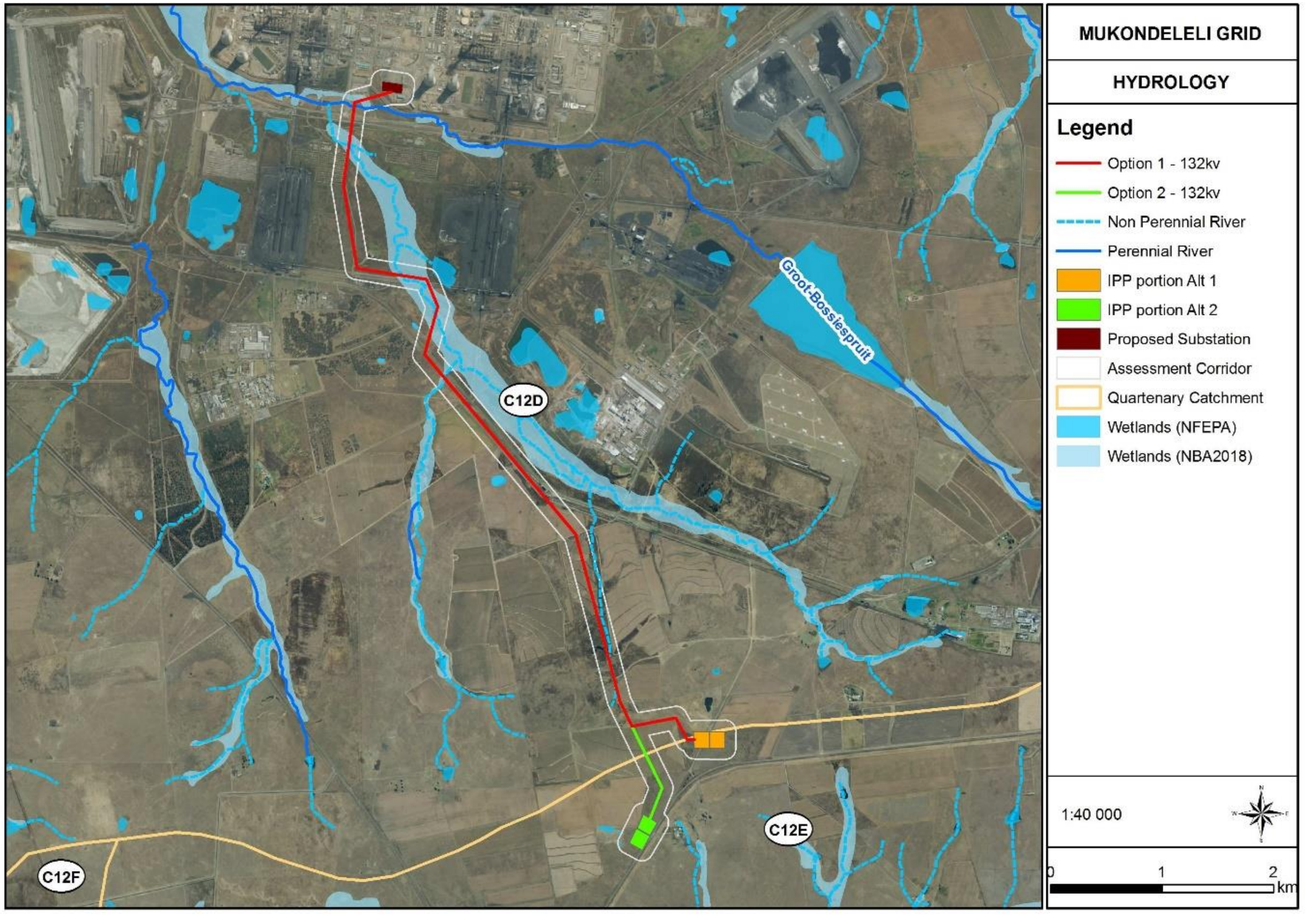


Figure 6-5: **Hydrology of the study site and surrounds as per existing spatial layers**

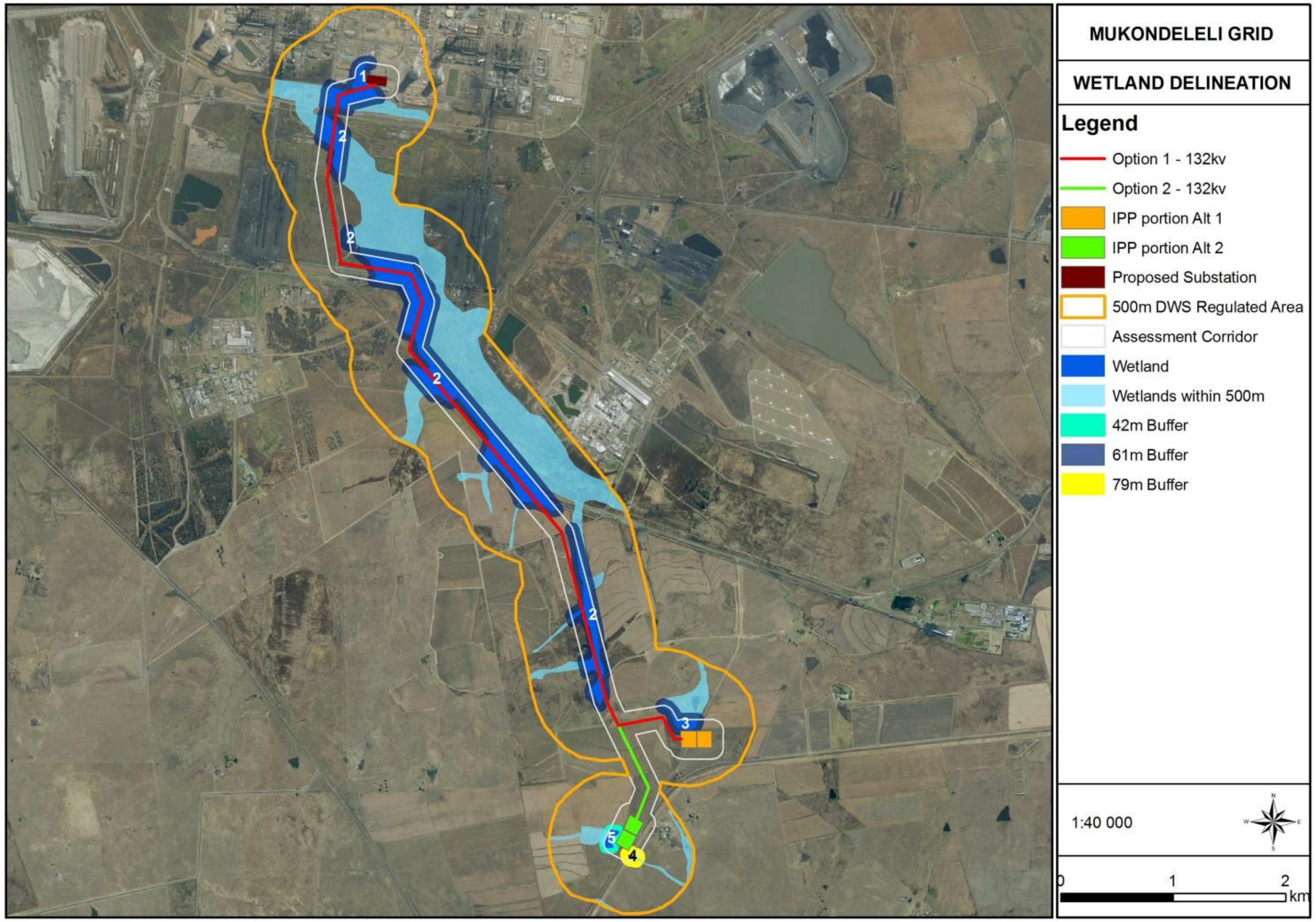


Figure 6-6: Delineated watercourses together with their calculated buffer zones and the 500 m DWS regulated area

It should be noted that the study occurred during a particularly high rainfall season and the vegetation growth was robust in an already very wet landscape, and wetness signatures were abundant albeit due to rare flooding events. Due to the high rainfall a few hydrophytic wetland species occurred in areas with poor drainage and prolonged saturation (such as roadsides and small depressions) that would not normally sustain wetland species. The soil of the study areas was characterised by dark clay soils which also may form temporary wet areas during high rainfall events.

Many of the wetlands were fragmented and/or encroached by current and historical agricultural lands. In the case of active agricultural fields where aerial images indicate potential wetness signature, the vegetation and soil was completely transformed and impacted and wetland species were not recorded here, although hydrologically the flow of wetlands are still potentially important features. The wetlands all occur on the same vegetation type known as Soweto Highveld Grassland (Mucina & Rutherford 2006), as well as previously being classified as Moist Clay Highveld Grassland (Low & Rebelo, 1996) and although individual wetlands will have some degree of unique vegetation, the dominant species are expected to be similar in composition. As previously mentioned, the agriculture and grazing, as well as many other recorded impacts affect the composition and increases Alien Invasive Species (AIS) recorded at and near these impacts.

The wetland areas were generally devoid of woody species. The dominant grasses and sedges recorded include: *Aristida congesta, Cynodon dactylon, Cyperus sexangularis, Cyperus congestus, Cyperus esculentus, Cyperus haematocephalus, Cyperus laevigatus, Cyperus longus, var. longus, Cyperus fastigiatus, Harpochloa falx, Imperata cylindrica , Digitaria eriantha, Eragrostis curvula, Eragrostis gummiflua, Eragrostis plana, Eragrostis racemose, Hyparrhenia hirta, Kyllinga erecta Paspalum urvillei, Paspalum dilatatum, Phragmites australis, Schoenoplectus corymbosus, Setaria sphacelata, Sporobolus africanus, Themeda triandra, Typha capensis.*

The dominant forb species recorded include: *Berkheya radula, Berula erecta Crinum bulbispermum, Gladiolus Spp, Haplocarpha scaposa, Helichrysum nudifolium, Helichrysum rugulosum, Hypoxis rigidula, Ipomoea crassipes, Monopsis decipiens, Oenothera rosea Oxalis obliquifolia, Persicaria spp, Persicaria lapathifolia Ranunculus multifidus Rumex crispus Vernonia oligocephala.*

Although the wetland areas were dominated by grass and sedges some AIS were also recorded, especially adjacent to agricultural land and other impacts. The dominant AIS recorded include*: Bidens Formosa, Bidens pilosa, Cirsium vulgaris, Conyza bonariensis, Datura stramonium Senecio inaequidens, Schkuhria pinnata, Solanum spp, Verbena bonariensis, Tagetes minuta, Xanthium strumarium.*

It should also be noted that several plant species of conservation concern are known to occur in the area or have been recorded in the study site These include: *Kniphofia typhoides, Boophone disticha, Hypoxis hemerocallidea, Crinum bulbispermum* and *Eucomis autumnalis.*

Two potential route options as well as two IPP portion substation alternatives in the south were investigated as well as one Substation in the north. The two routes follow the same route from the northern substation predominantly adjacent to Sasol access roads in a southern direction where the routes diverge to the two alternative IPP portion substation. Surface water from both the alternative IPP portions have increased significantly and are now wetter compared to images *circa* 1955. This indicates large impacts from the adjacent Sasol complex and other sources. Both substation options are located on areas not previously used for agriculture, however Substation Option two is located directly adjacent to an existing road and development here will have less impact compared to Substation Option 1 and is therefore suggested. The route options are similar and only differ at the end points near the proposed substations and Route Option 2 is thus the preferred option. However, due to both being in close proximity to wetlands and within the 500 m DWS regulated areas, the options should be weighed against the other specialist findings

PRESENT ECOLOGICAL STATE AND CONSERVATION IMPORTANCE

The Present Ecological State (PES) of a river, watercourse or wetland represents the extent to which it has changed from the reference or near pristine condition (Category A) towards a highly impacted system where there has been an extensive loss of natural habit and biota, as well as ecosystem functioning (Category E).

The PES scores have been revised for the country and based on the new models, aspects of functional importance as well as direct and indirect impacts have been included (DWS, 2014). The new PES system incorporates Ecological Importance (EI) and Ecological Sensitivity (ES) separately as opposed to Ecological Importance and Sensitivity (EIS) in the old model, although the new model is still heavily centred on rating rivers using broad fish, invertebrate, riparian vegetation and water quality indicators. The Recommended Ecological Category (REC) is still contained within the new models, with the default REC being B, when little or no information is available to assess the system or when only one of the above-mentioned parameters are assessed or the overall PES is rated between a C or D.

The PES, EI and ES was determined per Sub Quaternary Reaches (SQR) for Secondary Catchments in South Africa. The SQRs within close proximity to the site are as follows:

SQR 1657(PES=E), (EI=Low), (ES=Moderate)

SQR 1712(PES=C), (EI=High), (ES=High)

A PES of a B indicates the reach is largely natural, C indicates the reach is moderately modified, D indicates the reach is largely modified and a PES of E indicates that the reach is seriously modified.

A summary of the integrity scores for each wetland is listed in **Table 6-8** and is visually presented in Figure 6-7 and **Figure 6-8.**

Table 6-8: Summary of the scores of the wetland units

WETLAND NUMBER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
1	Floodplain Wetland	Drains into Grootbossiespruit	61m	D - Largely Modified	Ecological Importance & Sensitivity - Low Hydro-Functional Importance - Moderate Direct Human Benefits - Low	Biodiversity maintenance importance –Low Regulating services importance - Moderate Provisioning and cultural services importance - Low	Low	D – Maintain at D
2	Floodplain Wetland		61m	D - Largely Modified	Ecological Importance & Sensitivity - Low Hydro-Functional Importance - Moderate Direct Human Benefits - Low	Biodiversity maintenance importance –Low Regulating services importance - Moderate Provisioning and cultural services importance - Low	Low	D – Maintain at D

3	Seepage Wetland		61 m	D - Largely Modified	Ecological Importance & Sensitivity - Low Hydro-Functional Importance - Low Direct Human Benefits - Low	Biodiversity maintenance importance –Low Regulating services importance - Low Provisioning and cultural services importance - Low	Low	D – Maintain at D
4	Valley Bottom Wetland		79m	C -Moderately Modified	Ecological Importance & Sensitivity – Very High Hydro-Functional Importance - High Direct Human Benefits - High	Biodiversity maintenance importance –High Regulating services importance - High Provisioning and cultural services importance - Moderate	High	Maintain at C
5	Seepage with Artificial Characteristics historical trenches		42 m	E - Seriously Modified	Ecological Importance & Sensitivity - Low Hydro-Functional Importance - Low Direct Human Benefits - Low	Biodiversity maintenance importance –Low Regulating services importance - Low Provisioning and cultural services importance - Low	Low	Maintain at C

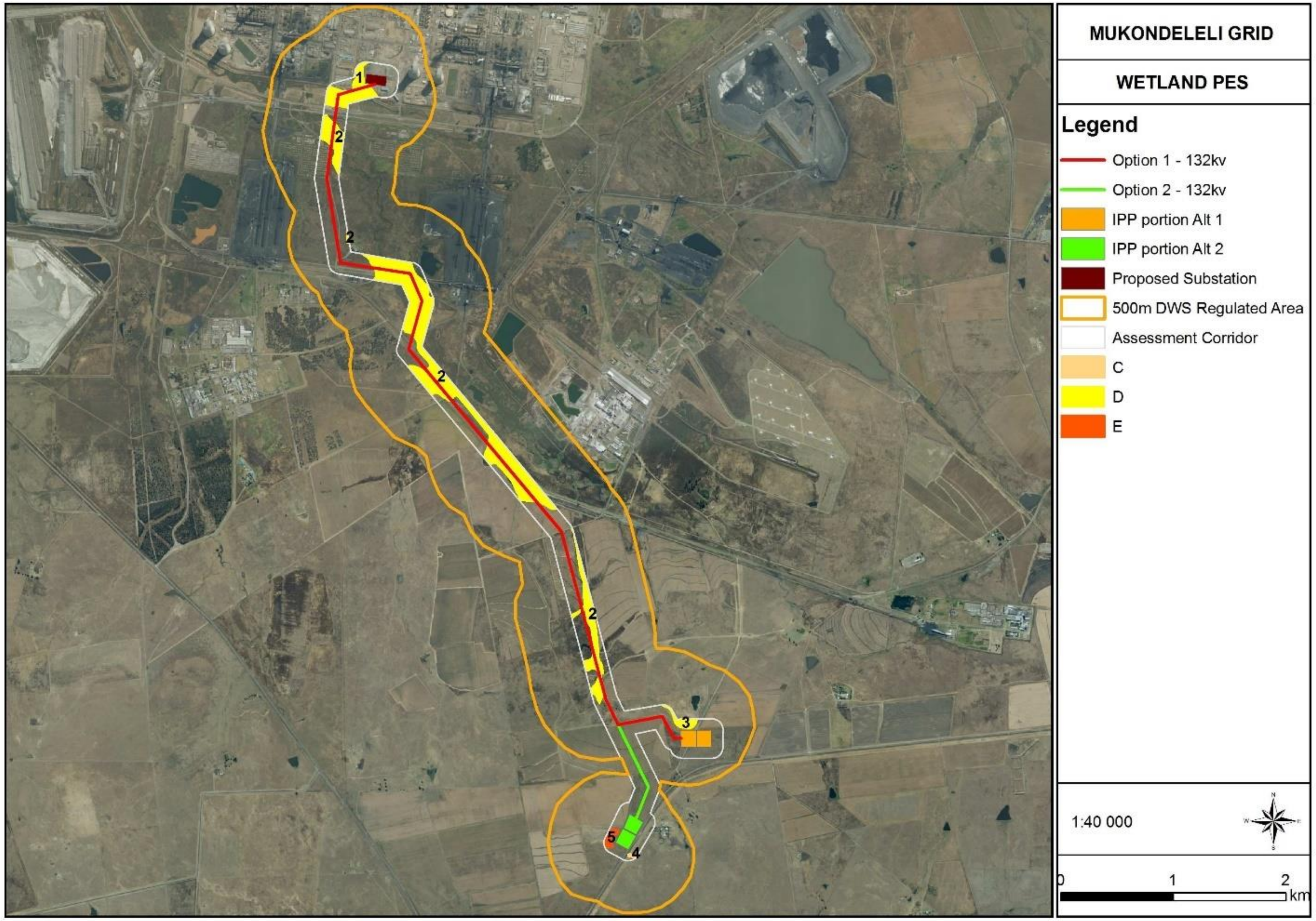


Figure 6-7: Present ecological state of each wetland unit in the proposed Mukondeleli gridline (Macfarlane et al., 2020).

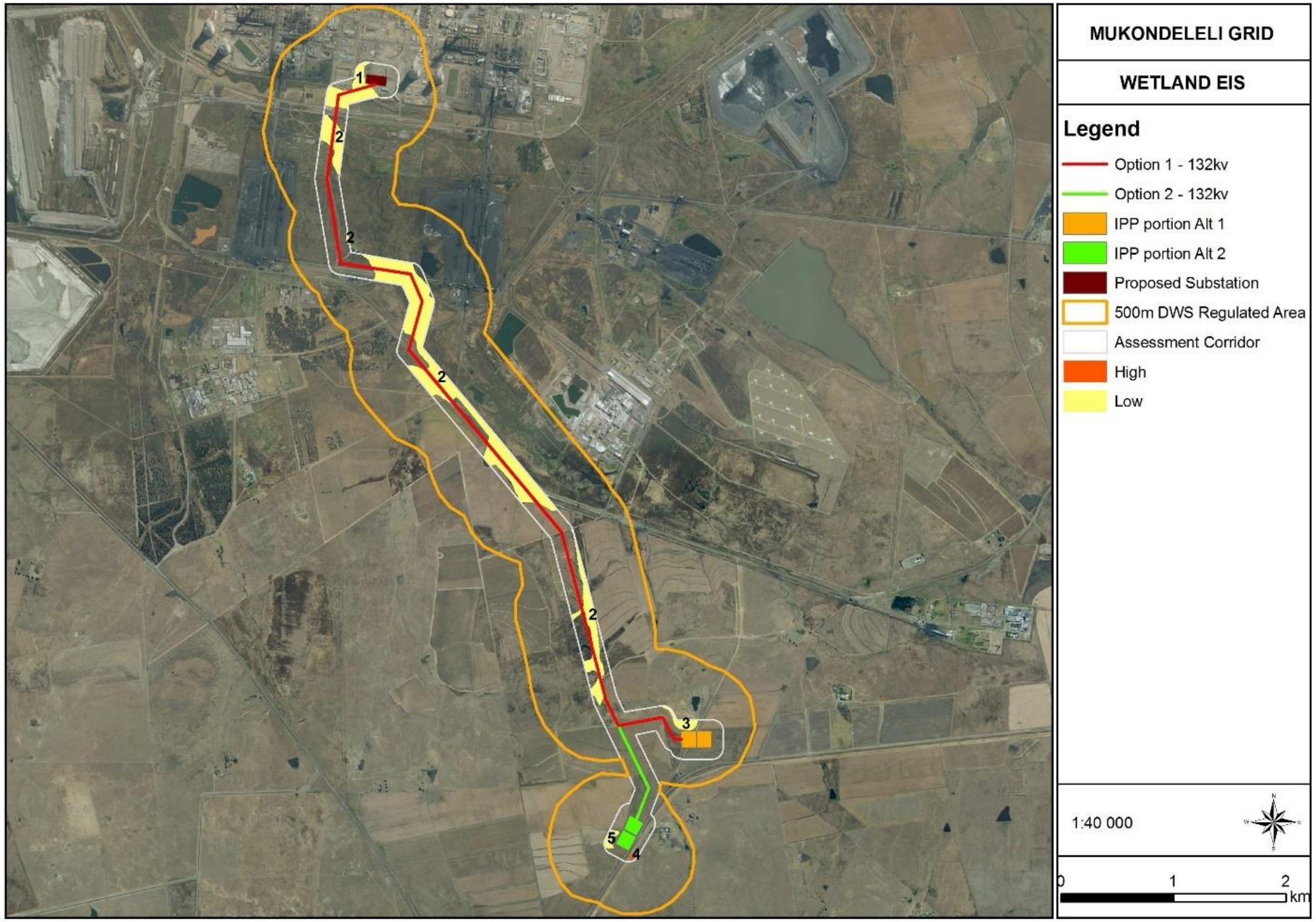


Figure 6-8: **Environmental Importance and Sensitivity category (EIS) of the proposed Mukondeleli gridline (*Kotze et al*., 2020)**

In 2014, the Mpumalanga Parks and Tourism Agency developed the MBSP. In essence the MBSP is a map guiding areas of conservation concern for the Mpumalanga Province. The MBSP maps the freshwater ecosystems of Mpumalanga into the following categories:

— CBAs – areas of high biodiversity value, needed to meet biodiversity targets. These areas should be maintained in natural or near natural state;
— ESAs – these areas support CBAs, but are not essential for meeting conservation targets;
— Other Natural Areas – these areas have natural characteristics but have not been earmarked as priority areas for conservation but perform a range of biological as well as ecological functions; and
— Heavily Modified Areas – Areas that have been impacted and have had a significant or complete loss of natural habitat and ecological function.

In terms of the freshwater assessment of the MBSP, the site includes mostly other natural areas and heavily modified areas. The site does contain an ESA and there is a small CBA present to the south of the centre of the site.

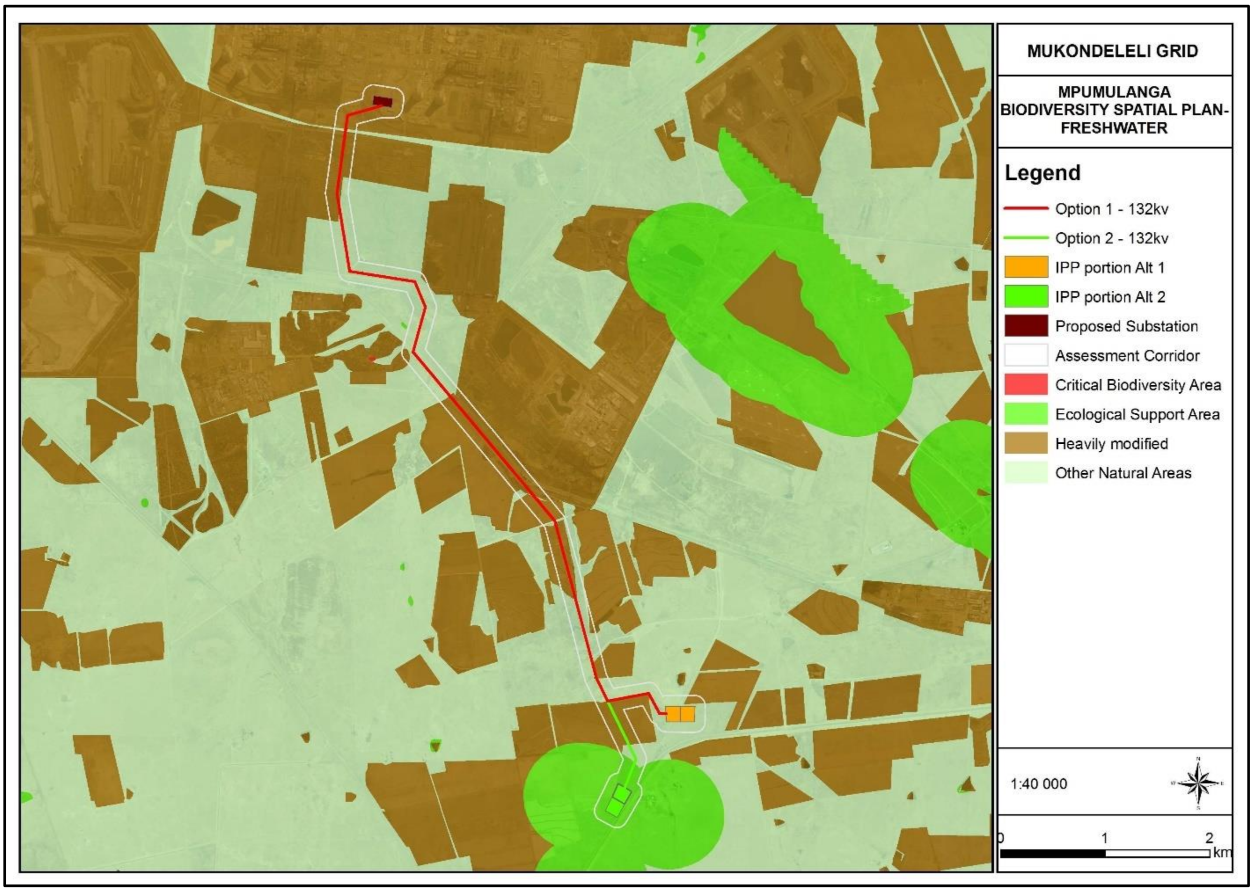


Figure 6-9: The proposed Mukondeleli Gridline in relation to the MBSP aquatic.

ECOLOGICAL IMPORTANCE

Based on the Species Environmental Assessment Guideline (SANBI, 2020) wetlands and specialised habitats should be assessed based on their Site Ecological Importance (SEI). Based on these methods the wetlands are determined as per the following (**Table 6-9**):

Table 6-9: Ecological Importance of all wetland areas recorded on the study site

HABITAT	CONSERVATION IMPORTANCE (CI)	FUNCTIONAL INTEGRITY (FI)	BIODIVERSITY IMPORTANCE	RECEPTOR RESILIENCE	SITE ECOLOGICAL IMPORTANCE
Wetland 1-4	High – Confirmed occurrence of wetlands within the development footprint	Medium – Some historical impacts and AIS recorded	Medium – Based on CI and FI	Very Low – Wetlands are not easily restored without significant rehabilitation. Many species are dependent on functional wetland habitat.	Based on BI – Medium and RR – Very Low = High
Wetland 5	Low – Due to historical trenches and some artificial inputs	Low – Large amounts of impacts	Low – Based on CI and FI	High – Due to artificial nature	Low

EXISTING IMPACTS NOTED ON WATERCOURSES DURING SITE VISIT

Development has several impacts on the surrounding environment and particularly on a wetland. The main impacts associated with the wetlands on the study are current and historical agriculture, as well as grazing animals. Several other impacts such as roads, Stormwater and other surface water inputs has an impact on the hydrology and water quality of the wetlands. Current and historical diggings and trenches have an impact on the geomorphology while the invasive species negatively impacts the vegetation composition of the wetlands.

6.2 BIOLOGICAL ENVIRONMENT

6.2.1 VEGETATION

The Mukondeleli gridline falls in the Grassland Biome and more specifically in the Mesic Highveld Grassland Bioregion (**Figure 6-10**). It is located in the Soweto Highveld Grassland (Gm8) national vegetation type which has a "Vulnerable" conservation status because almost half of it has been transformed, mostly by cultivation, plantations, mining and urbanisation. Overall, the vegetation on the Mukondeleli site is structurally a grassland. Based on species composition, six habitats (plant communities) were distinguished, described and mapped for the Mukondeleli site. A further four units were also distinguished, i.e. croplands, infrastructure, disturbed areas and dams. The site does not fall within any Centre of Plant Endemism.

During the field surveys, 290 plant species were recorded on the three Enertrag sites (Vhuvhili, Mukondeleli and Impumelelo). Combined, the checklist generated by the NewPosa database for the region, the red-list for Mpumalanga (Lötter 2015) and the list for the current field study yielded 396 species for the region of which 30 are protected species according to the Mpumalanga Nature Conservation Act (MNCA) (1998).

Twelve of the 30 Mpumalanga protected plant species (Schedule 11) were recorded during the site survey. Another five species are on the Mpumalanga Red list (Lötter 2015) although not included in the MNCA (1998) list for Mpumalanga. None of the Species of Conservation Concern (SCC) listed by the Screening Tool were encountered on the Mukondeleli site during the site visit. None of the seven SCCs (sensu SANBI SCC definition) listed for the region were recorded on the Mukondeleli site although Gladiolus robertsoniae was noted at the Impumelelo site. No threatened or protected species (ToPS listed) under the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) is listed for the Mukondeleli site and none were found at the site. Thirteen (13) CITES Appendix II species are listed for the region including mostly (10) species of the Orchidaceae. Aloe ecklonis, Aloe transvaalensis and Euphorbia clavarioides were the CITES species recorded on the Mukodeleli site. No nationally protected tree species is listed for the site and none were recorded during the site visit. No endemic species are listed for the Soweto Highveld Grassland Vegetation Type. Forty-seven alien plant species were recorded on the three Enertrag sites of which 12 are currently declared alien invasive species and 35 naturalised alien species (Appendix B). Another four naturalised alien species are listed by NewPosa for the region

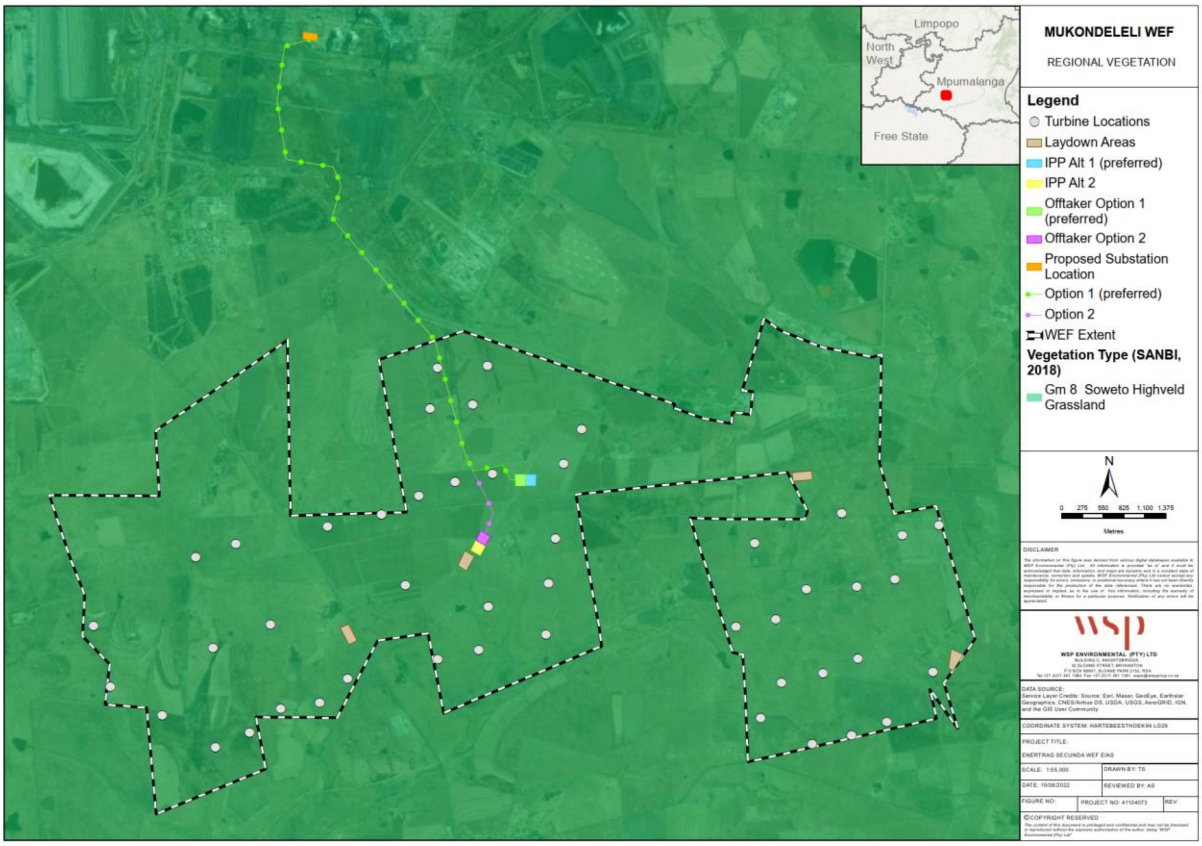


Figure 6-10: Regional Vegetation.

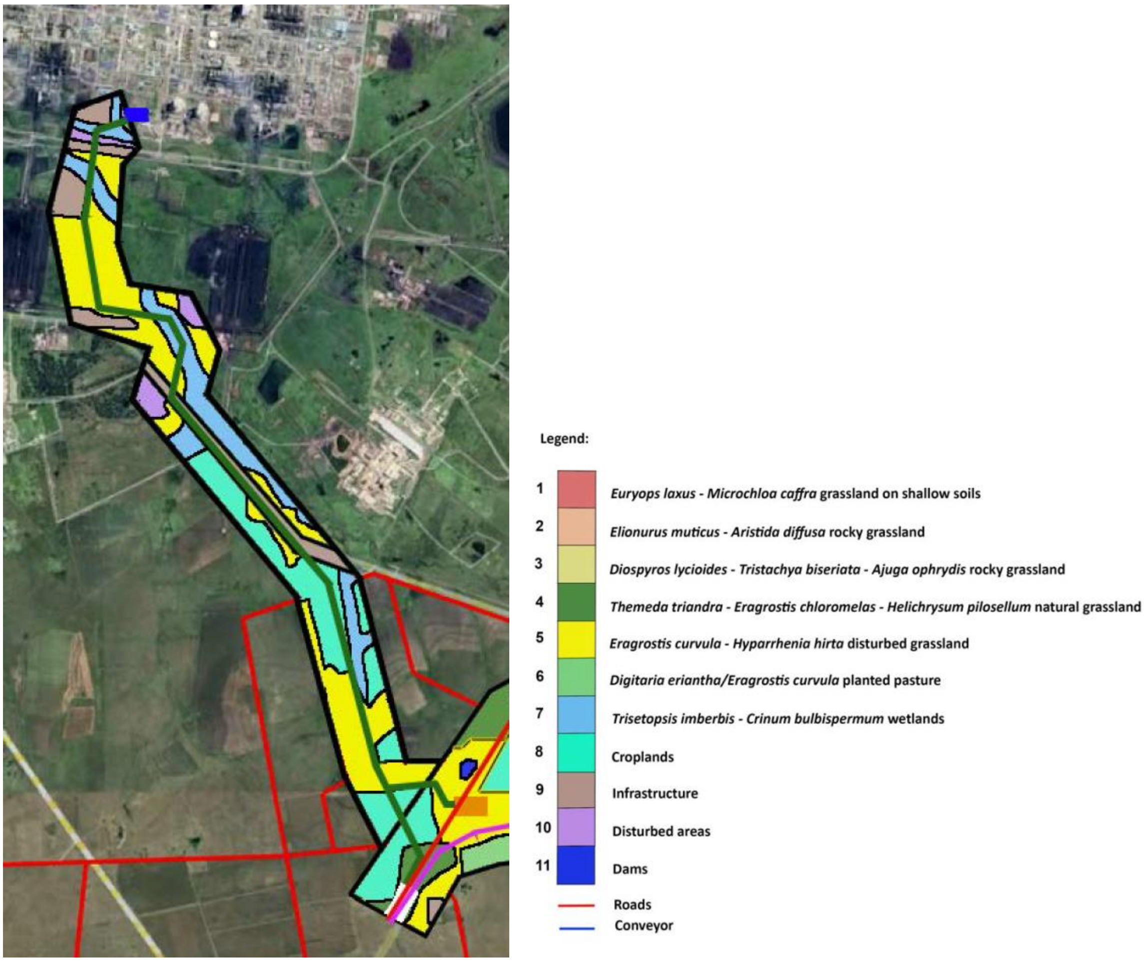


Figure 6-11: Vegetation Map of the Mukondeleli Gridline Route

CONSERVATION STATUS OF THE VEGETATION TYPE

On the basis of a scientific approach used at national level by SANBI (Driver *et al.*, 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie, 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in **Figure 6-12**, as determined by best available scientific approaches (Driver *et al.*, 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al.*, 2005).

According to scientific literature (Driver *et al.*, 2005; Mucina *et al.*, 2006) this vegetation type was listed as "Endangered". Very few statutorily conserved areas occur in this vegetation type and almost half of it has been transformed, mostly by cultivation, plantations, mining and urbanisation

Determining ecosystem status (Driver *et al.*, 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)			
	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

Figure 6-12: Ecosystem Status (Driver et al. 2005)

The National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the NEM:BA, lists national vegetation types, and other ecosystems defined in the Act, that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature. The Soweto Highveld Grassland is listed as Vulnerable in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011).

6.2.2 BIODIVERSITY CONSERVATION PLANS

The MBSP) (Mpumalanga Parks and Tourism Agency, 2014) classifies the natural vegetation of the province according to the following categories:

— Protected Areas (sub-divided into three categories);
— CBAs (sub-divided into “Irreplaceable” and “Optimal”);
— Other natural areas;
— ESAs (sub-divided into four categories); and
— Modified (sub-divided into Heavily or Moderately modified.

CBAs are areas required to meet biodiversity targets for ecosystems, species or ecological processes. CBAs are regarded as areas of high biodiversity and ecological value and need to be kept in a natural or near-natural state, with no further loss of habitat or species. The definitions for CBAs are (SANBI 2018):

— CBA 1: Areas that are irreplaceable for meeting biodiversity targets. There are no other options for conserving the ecosystems, species or ecological processes in these areas (SANBI 2018).
— CBA 2: Areas that are the best option for meeting biodiversity targets, in the smallest area, while avoiding conflict with other land uses.

It is assumed that the terms ‘CBA irreplaceable’ in the MBSP is equivalent of a CBA1 and a ‘CBA optimal’ refers to a CBA2. The CBA map in **Figure 6-13** indicates the presence of CBA1 and a CBA2 across a large section of especially the farm Bosjesspruit. The Mukondeleli on-site substation is located in a CBA2 and should be repositioned. Sections of the Option 1 gridline traverse CBA1 and CBA2s in the south. The alternative route of the gridline, although longer, would thus be less of a conservation issue than the Option 1 gridline route.

The main reasons provided for the mapping of the CBAs on Mukondeleli were (data provided by M. Lötter, MTPA):

— Soweto Highveld Grassland
— Mesic Highveld Grassland (wetlands) – Groups 1 – 3
— Wetland clusters
— Intact grassland patches
— African bullfrog *Pyxicephalus adspersus*
— African Grass Owl *Tyto capensis*
— Climate change land facets
— Critical linkages
— Macro, core and supporting corridors

Figure 6-13 shows the features in the study area within the classes listed above.

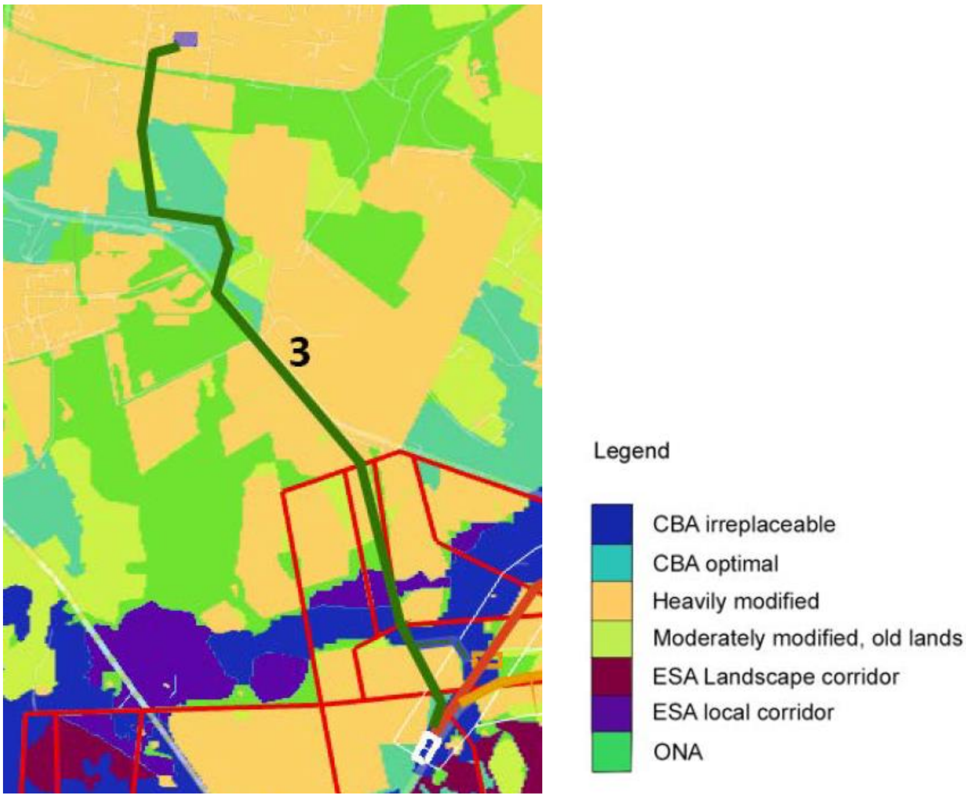


Figure 6-13: Biodiversity Map of the Project Area according to the MBSP Terrestrial

ECOLOGICAL PROCESSES, FUNCTIONING AND DRIVERS

Ecological processes include primary production, decomposition, nutrient cycling and fluxes of nutrients and energy. These processes will be altered by the clearing of the vegetation at the footprint of the gridline infrastructure. However, the impact is expected to be fairly small. Since grasses are wind pollinated, pollination of the grass component should not be unduly affected by the development, although the forbs will depend on pollinators. Roads required for operation are likely to still be of a natural surface such as gravel and would experience low traffic volumes, thus migration of ground-dwelling organisms will be hindered locally during construction, but ecological connectivity should not be disrupted during the operational phase. Overall, broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions should be able to continue due to the small footprint of the development. The infrastructure, if properly planned, should not cut off ecological corridors and habitat fragmentation due to the development should not be an issue.

The disturbance caused during construction will inevitably create conditions favourable for invasion by alien species. Since, the level of alien infestation at the site was moderate, an alien invasive plant species monitoring and control programme needs to be initiated to control invasions.

Fire is considered an important driver of vegetation dynamics in the Grassland and Savanna Biomes. Should fire be suppressed on site this could have long-term effects on the vegetation dynamics.

6.2.3 PROPOSED PROTECTED AREAS

The study site is not located in a protected area, in terms of the NEMA:PAA.

According to the National Protected Areas Expansion Strategy 2008 (NPAES2008), there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore **outside the NPAES focus area**. A draft National Protected Areas Expansion Strategy was published for public comment in 2018 but is deliberately not available as a spatial dataset. It does, however, reference the

Mpumalanga Protected Area Expansion Strategy, in which priority areas are identified in terms of High, Medium and Low priorities. The site is also not earmarked in the 5-year plan of the Mpumalanga PAES (data supplied by M. Lötter, MTPA).

6.2.4 PLANT SPECIES

Lists of plant species previously recorded in the study area were obtained from the South African National Biodiversity Institute (SANBI) website (http://newposa.sanbi.org/). The NewPosa data search yielded 147 plant species. During the field surveys, 290 plant species were recorded on the Enertrag sites and additionally eight species were listed for the region (data supplied by M. Lötter, MTPA). Combined, these sources yielded 396 species for the region of which 30 are protected species according to the MNCA (1998).

Khadia beswickii and *Nerine gracilis* are the only IUCN threatened species occurring in the region. Near Threatened (NT), Data Deficient (DDD) and Data Deficient (Taxononically) (DDT) species are not classified as threatened according to the IUCN classification.

SPECIES OF CONSERVATION CONCERN

According to the South African National Biodiversity Institute (SANBI 2020), SCCs include all species that have been assessed according the IUCN Threatened or Red-List Criteria as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Data Deficient (DD), as well as range-restricted species which are not declining and are nationally listed as Rare or Critically Rare. The DD category is split into those that are taxonomically unresolved (DDT) and those where insufficient data (DDD) are available to make a judgement on endangered status.

The Taxonomically Data Deficient (DDT) species were excluded as SCC since taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of extinction risk is not possible.

The SCC species listed for the region are:

- Argyrolobium campicola = NT
- Gladiolus robertsoniae = NT
- Habenaria barbertoni = NT
- Khadia beswickii = VU (data supplied by M. Lötter, MTPA)
- Kniphofia typhoides = NT (data supplied by M. Lötter, MTPA)
- Nerine gracilis = VU (data supplied by M. Lötter, MTPA)
- Stenostelma umbelluliferum = NT

None of these species were recorded on the Mukondeleli site.

PROTECTED SPECIES

A total of 30 plant species are listed as Schedule 11 Protected plant species in the region according to the MNCA (1998) (Appendix B). Most of these species are members of the *Amaryllidaceae* and *Orchidaceae*. Twelve of the 30 protected plant species (Schedule 11) were recorded during the site survey in December 2021 of which only five species were recorded on Mukondeleli.

. The five species recorded are:

- *Aloe ecklonis*
- *Aloe transvaalensis*
- *Crinum bulbispermum*
- *Cyrtanthus stenanthus*
- *Gladiolus crassifolius*

Another five species are on the Mpumalanga Red list (Lötter, 2015) although not included in the MNCA (1998) list for Mpumalanga:

Drimia angustifolia = LC
Hypoxis hemerocallidea = LC
Khadia beswickii = VU
Nerine gracilis = VU
Trachyandra erythrorrhiza = NT

TOPS LIST

No species classified as protected within the NEM:BA is listed for the study area and none were found at the Mukondeleli site.

CITES APPENDICES

Appendix II of CITES lists species that are not necessarily now threatened with extinction, but that may become so unless trade is closely controlled. Thirteen (13) Appendix II species are listed for the region including mostly (10) species of the Orchidaceae. *Aloe ecklonis, Aloe transvaalensis and Euphorbia clavarioides* are CITES-listed species that were recorded on the Mukondeleli site.

PROTECTED TREE SPECIES

No nationally protected tree species is listed for the site (NFA, 2021) and none were recorded during the site visit.

ENDEMIC SPECIES

No endemic species were listed for the Soweto Highveld Grassland Vegetation Type (Mucina & Rutherford, 2006).

6.2.5 TERRESTRIAL FAUNA SPECIES

The site falls within the distribution range of 52 mammal species (http://vmus.adu.org.za)

SCREENING TOOL

The screening tool rated the sensitivity of the Animal Species Theme as high and highlighted the following speciesl:

- Aves - *Circus ranivorus* (African Marsh Harrier);
- Aves - *Sagittarius serpentarius* (Secretarybird);
- Insecta - *Lepidochrysops procera; and*
- Mammalia - *Crocidura maquassiensis* (Maquassie Musk Shrew).

The avifaunal and bat components will be addressed by the avifaunal and bat specialists. The Maquassie Musk Shrew Crocidura maquassiensis, classified as Vulnerable (Taylor et al. 2016), was not listed in the ADU mammal species list or the MNCA (1998) lists for the Mpumalanga province.It was not listed in the MTPA database for the farms participating in the proposed Mukondeleli WEF development and was not recorded on site during the survey. It depends on wetlands as suitable habitat in savanna and grasslands. Although it has a wide inferred extent of occurrence, it appears to be patchily distributed. The main threats are the loss or degradation of moist, productive areas such as wetlands and rank grasslands within suitable habitat. Crocidura maquassiensis has not been reported from Gauteng, North West Province or Mpumalanga post-1999 and thus there is a very low probability for it to occur on site.

IUCN THREATENED MAMMAL SPECIES

Three IUCN threatened mammal species were listed for the environs of the Mukondeleli site on the website of the Animal Demography Unit, University of Cape Town (**Table 6-10**).

Table 6-10: Mammal species of conservation concern with a likelihood of occurring on site

SCIENTIFIC NAME	COMMON NAME	STATUS
Ourebia ourebi	Oribi	Endangered
Felis nigripes	Black-footed Cat	Vulnerable, protected
Panthera pardus	Leopard	Vulnerable, protected

Seven mammal species were listed for the environs of the Mukondeleli site as Near Threatened (a category that is not a threatened category in the IUCN classification but qualifies as SCC (**Table 6-11**).

Table 6-11: Near Threatened Mammal Species at the project site

SCIENTIFIC NAME	COMMON NAME	STATUS
Amblysomus septentrionalis	Highveld Golden mole	Near Threatened
Atelerix frontalis	Southern African hedgehog*	Near Threatened
Leptailurus serval	Serval*	Near Threatened
Otomys auratus	Southern African vlei rat	Near Threatened
Aonyx capensis	African Clawless otter	Near Threatened
Poecilogale albinucha	African Striped weasel	Near Threatened
Crocidura mariquensis	Swamp musk shrew	Near Threatened

*Mammals that were either sighted or confirmed by the landowners.

MPUMALANGA: PROVINCIALLY PROTECTED MAMMAL SPECIES

Six of the 52 mammal species listed in Appendix C are Schedule 2: Protected Game in Mpumalanga. The following mammal species were recorded on the Mukondeleli site (**Table 6-12**):

Table 6-12: : Provincially Protected Mammal Species

SCIENTIFIC NAME	COMMON NAME
Raphicerus campestris	Steenbok
Atelerix frontalis	Southern African hedgehog

NATIONALLY THREATENED OR PROTECTED SPECIES: TOPS

According to ToPS legislation (NEMBA), one mammal species is listed as Endangered, one mammal species is listed as Vulnerable and six species are Protected (**Table 6-13**).

Endangered: Indigenous species facing a high risk of extinction in the wild in the medium-term future, although they are not critically endangered.

Table 6-13: ToPS Endangered Species

SCIENTIFIC NAME	COMMON NAME
Ourebia ourebi	Oribi

Vulnerable: Indigenous species facing a high risk of extinction in the wild in the medium-term future, although they are not critically endangered or endangered (**Table 6-14**).

Table 6-14: ToPS Vulnerable Species

SCIENTIFIC NAME	COMMON NAME
Panthera pardus	Leopard

Protected species: Indigenous species of high conservation value or national importance that require national protection (**Table 6-15**).

Table 6-15: ToPS Protected Species

SCIENTIFIC NAME	COMMON NAME
Aonyx capensis	African clawless otter
Ateerix frontalis	Southern African hedgehog*
Connochaetes gnou	Black wildebeest*
Felis nigripes	Black-footed cat
Leptailurus serval	Serval*
Vulpes chama	Cape fox

*Mammals that were either sighted or confirmed by the landowners.

CITES

The following mammal species occurring in the region are CITES listed (**Table 6-16)**.

Table 6-16: CITES Mammal Species

SCIENTIFIC NAME	COMMON NAME	STATUS
Aonyx capensis	African Clawless otter	Appendix II
Leptailurus serval	Serval*	Appendix II
Caracal caracal	Caracal	Appendix II
Panthera pardus	Leopard	Appendix I

*Mammals that were either sighted or confirmed by the landowners.

REPTILES

A total Thirty-two (32) reptile species are listed for the region. The list includes one IUCN threatened (Vulnerable) species, i.e. the Giant Girdled Lizard (*Smaug giganteus*) and one Near-threatened species, i.e. *Chamaesaura aenea* (Coppery Grass Lizard) (**Table 6-17**).

Provincially protected reptile species include 15 Schedule 2 Protected reptiles and 17 Schedule 5 reptiles. The Giant Girdled Lizard (Smaug giganteus) is listed as Endangered according to the ToPS list (NEMBA 2007c). The only reptile that has been recorded on the Mukondeleli site is the rinkhals *Hemachatus haemachatus*.

Table 6-17: CITES-listed Reptile Species

SCIENTIFIC NAME	COMMON NAME
Smaug giganteus	Giant Girdled Lizard (Ouvolk)
Cordylus vittifer	Common Girdled Lizard

AMPHIBIANS

Fourteen species were listed for the region and all have an IUCN status of Least Concern. None of the frog species listed for the region has a MNCA or ToPS protected status (MNCA 1998, NEMBA 2007c).

LEPIDOPTERA

Only one of the 62 species of the Lepidoptera listed for the region is IUCN listed as Endangered, i.e. *Chrysoritis aureus* (Golden opal).

The Screening Tool listed Lepidochrysops procera as a sensitive species for the site. However, it was not listed in the ADU website (http://vmus.adu.org.za), the MNCA (1998) provincial species lists or the NEMBA (2007c) ToPS lists. Although *Lepidochrysops procera* has a IUCN status of Least Concern, it is a habitat specialist and is rated as Rare. It is not regarded as sensitive in the National Sensitive Species List of SANBI and is not exploited, collected, traded or utilised in a targeted manner (http://nssl.sanbi.org.za/species/lepidochrysops-procera accessed October 2021). Its habitat is rocky areas in grassland (and grassy areas in savanna), where its larval host plant, Ocimum obovatum, occurs. Lepidochrysops procera is unlikely to occur on site because its host plant was not recorded on site.

SCORPIONS

One scorpion species is listed for the 2629C and 2628D locus.

SPIDERS

All baboon spiders are provincially Schedule 7 protected. The listed baboon spider *Harpactira hamiltoni* is a ToPS protected species (NEMBA 2007c).

6.2.6 AVIFAUNA

IMPORTANT BIRD AREAS

The project site is not located in an Important Bird Area (IBA). The closest IBAs are the Amersfoort-Bethal-Carolina IBA SA018 – approximately 27km east of the Mukondeleli Grid Connection – and the Devon Grasslands IBA SA130 – approximately 27.5km west of the Mukondeleli Grid Connection (Marnewick et al., 2015). It is not envisaged that the proposed Grid Connection will impact on avifauna in either of the IBAs due to the distance from the PAOI.

BIRD HABITAT

Whilst much of the distribution and abundance of the bird species in the development areas can be explained by the dominant biomes and vegetation types, it is also important to examine the modifications which have changed the natural landscape, and which may influence the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types and are determined by a host of factors such as topography, land use and man-made infrastructure.

The following bird habitat classes were identified in the development areas:

GRASSLAND

There are large areas of natural grassland remaining in the development area (**Figure 6-14**). The grassland varies from dense stands of relatively high grass to areas of heavily grazed short grass. The powerline priority species which could have the potential to use the natural grassland in the development are listed in **Table 6-18**.

Table 6-18: Powerline priority species which may use the natural grasslands in the development area. Red List species are highlighted in red.

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
African Sacred Ibis	Least Concern	Least Concern	High
Amur Falcon	Least Concern	Least Concern	High
Black-headed Heron	Least Concern	Least Concern	High
Black-winged Kite	Least Concern	Least Concern	High
Blue Crane	Vulnerable	Near Threatened	Medium
Blue Korhaan	Near Threatened	Least Concern	Medium
Cape Crow	Least Concern	Least Concern	Medium
Common Buzzard	Least Concern	Least Concern	Medium
Egyptian Goose	Least Concern	Least Concern	High
Greater Kestrel	Least Concern	Least Concern	Medium
Hadada Ibis	Least Concern	Least Concern	High
Helmeted Guineafowl	Least Concern	Least Concern	High
Jackal Buzzard	Least Concern	Least Concern	Medium
Lanner Falcon	Least Concern	Vulnerable	Medium
Long-crested Eagle	Least Concern	Least Concern	Medium
Marsh Owl	Least Concern	Least Concern	High
Northern Black Korhaan	Least Concern	Least Concern	Medium
Pallid Harrier	Near Threatened	Near Threatened	Medium
Pied Crow	Least Concern	Least Concern	High
Rock Kestrel	Least Concern	Least Concern	Medium
Secretarybird	Endangered	Vulnerable	Medium
Spotted Eagle-Owl	Least Concern	Least Concern	Medium
Spur-winged Goose	Least Concern	Least Concern	High
Western Cattle Egret	Least Concern	Least Concern	High
White Stork	Least Concern	Least Concern	Medium
Red-footed Falcon	Near Threatened	Near Threatened	Low
Western Barn Owl	Least Concern	Least Concern	Low

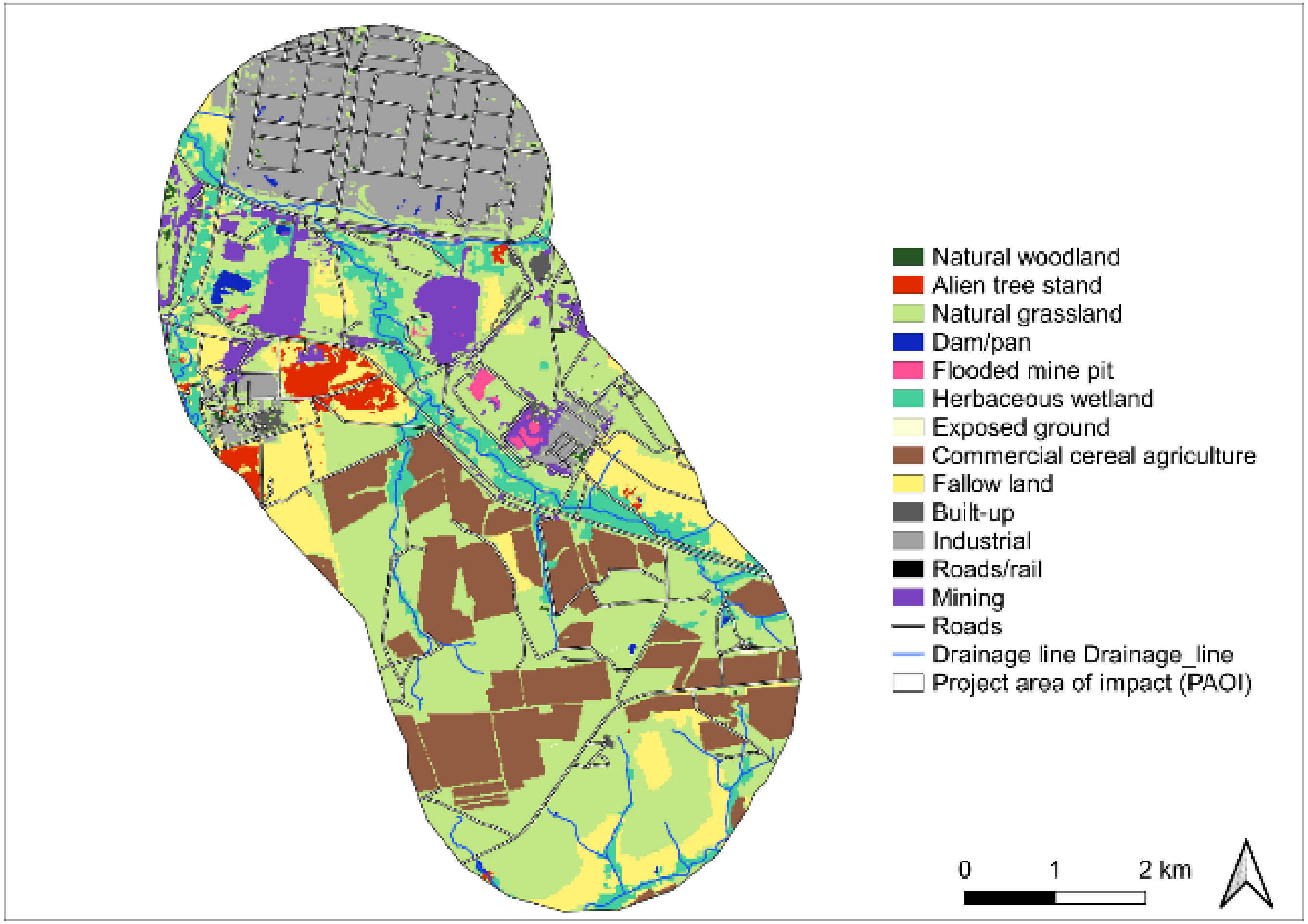


Figure 6-14: Land-cover and land-use within the Project Site Development Area according to the 2018 national land-cover surveys (DEA & DALRRD, 2019)

DRAINAGE LINES AND WETLANDS

There are several streams, floodplains, and associated wetlands throughout the PAOI, and grasslands are prone to inundation during the summer wet season . Surface rocks are present in some places along the streams. The alluvial soils are mostly deep dark brown to black clayey soils. The powerline priority species which could have the potential to use the drainage lines and wetlands in the development are listed in **Table 6-19**.

Table 6-19: Powerline priority species which may use the drainage lines and wetlands in the development area. Red List species are highlighted in red

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
African Black Duck	Least Concern	Least Concern	Medium
African Darter	Least Concern	Least Concern	High
African Sacred Ibis	Least Concern	Least Concern	High
African Spoonbill	Least Concern	Least Concern	High
African Swamphen	Least Concern	Least Concern	Medium
Blue Crane	Vulnerable	Near Threatened	Medium
Cape Shoveler	Least Concern	Least Concern	High
Common Moorhen	Least Concern	Least Concern	High
Egyptian Goose	Least Concern	Least Concern	High
Glossy Ibis	Least Concern	Least Concern	High
Goliath Heron	Least Concern	Least Concern	Medium
Great Egret	Least Concern	Least Concern	Medium
Grey Heron	Least Concern	Least Concern	High
Hadada Ibis	Least Concern	Least Concern	High
Hamerkop	Least Concern	Least Concern	Medium
Intermediate Egret	Least Concern	Least Concern	High
Little Egret	Least Concern	Least Concern	High
Long-crested Eagle	Least Concern	Least Concern	Medium
Mallard	Least Concern	Least Concern	Medium
Marsh Owl	Least Concern	Least Concern	High
Purple Heron	Least Concern	Least Concern	Medium
Red-billed Teal	Least Concern	Least Concern	High
Reed Cormorant	Least Concern	Least Concern	High
South African Shelduck	Least Concern	Least Concern	Medium
Southern Pochard	Least Concern	Least Concern	Medium
Spur-winged Goose	Least Concern	Least Concern	High
Squacco Heron	Least Concern	Least Concern	Medium

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
White-breasted Cormorant	Least Concern	Least Concern	High
White-faced Whistling Duck	Least Concern	Least Concern	High
Yellow-billed Duck	Least Concern	Least Concern	High
African Marsh Harrier	Least Concern	Endangered	Low
African Openbill	Least Concern	Least Concern	Low
Black Heron	Least Concern	Least Concern	Low
Black-crowned Night Heron	Least Concern	Least Concern	Low
Blue-billed Teal	Least Concern	Least Concern	Low
Cape Teal	Least Concern	Least Concern	Low
Fulvous Whistling Duck	Least Concern	Least Concern	Low
Great Crested Grebe	Least Concern	Least Concern	Low
Knob-billed Duck	Least Concern	Least Concern	Low
Maccoa Duck	Vulnerable	Near Threatened	Low
White-backed Duck	Least Concern	Least Concern	Low

DAMS AND PANS

There are several small and moderately sized dams, as well as a few small pans, mostly associated with the Klipspruit River and its tributaries (Figure 6-14). The powerline priority species which could have the potential to use the dams and pans in the development are listed in **Table 6-20**.

Table 6-20: Powerline priority species which may use the dams and pans in the development area. Red List species are highlighted in red

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
African Black Duck	Least Concern	Least Concern	Medium
African Darter	Least Concern	Least Concern	High
African Sacred Ibis	Least Concern	Least Concern	High
African Spoonbill	Least Concern	Least Concern	High
Blue Crane	Vulnerable	Near Threatened	Medium
Cape Shoveler	Least Concern	Least Concern	High
Common Moorhen	Least Concern	Least Concern	High
Egyptian Goose	Least Concern	Least Concern	High
Glossy Ibis	Least Concern	Least Concern	High
Goliath Heron	Least Concern	Least Concern	Medium
Great Egret	Least Concern	Least Concern	Medium

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
Greater Flamingo	Least Concern	Near Threatened	Medium
Grey Heron	Least Concern	Least Concern	High
Hamerkop	Least Concern	Least Concern	Medium
Intermediate Egret	Least Concern	Least Concern	High
Little Egret	Least Concern	Least Concern	High
Little Grebe	Least Concern	Least Concern	High
Mallard	Least Concern	Least Concern	Medium
Purple Heron	Least Concern	Least Concern	Medium
Red-billed Teal	Least Concern	Least Concern	High
Red-knobbed Coot	Least Concern	Least Concern	High
Reed Cormorant	Least Concern	Least Concern	High
South African Shelduck	Least Concern	Least Concern	Medium
Southern Pochard	Least Concern	Least Concern	Medium
Spur-winged Goose	Least Concern	Least Concern	High
Squacco Heron	Least Concern	Least Concern	Medium
White-breasted Cormorant	Least Concern	Least Concern	High
White-faced Whistling Duck	Least Concern	Least Concern	High
Yellow-billed Duck	Least Concern	Least Concern	High
African Fish Eagle	Least Concern	Least Concern	Low
African Openbill	Least Concern	Least Concern	Low
Black Heron	Least Concern	Least Concern	Low
Blue-billed Teal	Least Concern	Least Concern	Low
Cape Teal	Least Concern	Least Concern	Low
Great Crested Grebe	Least Concern	Least Concern	Low
Knob-billed Duck	Least Concern	Least Concern	Low
Maccoa Duck	Vulnerable	Near Threatened	Low
White-backed Duck	Least Concern	Least Concern	Low

AGRICULTURAL LANDS

Agricultural activity present within the Mukondeleli Grid Connection comprises cultivated commercial annuals non-pivot cropland (**Figure 6-14**), predominately dedicated towards maize production. Some fields are lying fallow or are in the process of being re-vegetated by grass. The powerline priority species which could have the potential to use the agricultural habitats in the development are listed in **Table 6-21**.

Table 6-21: powerline priority species which may use the agricultural habitats in the development area. Red List species are highlighted in Red

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
African Sacred Ibis	Least Concern	Least Concern	High
Amur Falcon	Least Concern	Least Concern	High
Black-headed Heron	Least Concern	Least Concern	High
Black-winged Kite	Least Concern	Least Concern	High
Blue Crane	Vulnerable	Near Threatened	Medium
Cape Crow	Least Concern	Least Concern	Medium
Common Buzzard	Least Concern	Least Concern	Medium
Egyptian Goose	Least Concern	Least Concern	High
Greater Kestrel	Least Concern	Least Concern	Medium
Hadada Ibis	Least Concern	Least Concern	High
Helmeted Guineafowl	Least Concern	Least Concern	High
Jackal Buzzard	Least Concern	Least Concern	Medium
Lanner Falcon	Least Concern	Vulnerable	Medium
Marsh Owl	Least Concern	Least Concern	High
Pied Crow	Least Concern	Least Concern	High
Rock Kestrel	Least Concern	Least Concern	Medium
Spotted Eagle-Owl	Least Concern	Least Concern	Medium
Spur-winged Goose	Least Concern	Least Concern	High
Western Cattle Egret	Least Concern	Least Concern	High
Red-footed Falcon	Near Threatened	Near Threatened	Low
Western Barn Owl	Least Concern	Least Concern	Low

ALIEN TREES

The development area contains few trees (**Figure 6-14**). Most trees are alien species, particularly Eucalyptus, Australian Acacia (Wattle), and Salix (Willow) species. Trees are often planted as wind breaks next to agricultural lands and around homesteads. Some of the drainage lines also have trees growing in them. The powerline priority species which could have the potential to use the alien trees in the development are listed in **Table 6-22**.

Table 6-22: Powerline priority species which may use the alien trees in development area. Red list species are highlighted in red

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
African Sacred Ibis	Least Concern	Least Concern	High
African Spoonbill	Least Concern	Least Concern	High

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
Amur Falcon	Least Concern	Least Concern	High
Black Sparrowhawk	Least Concern	Least Concern	Medium
Black-headed Heron	Least Concern	Least Concern	High
Black-winged Kite	Least Concern	Least Concern	High
Cape Crow	Least Concern	Least Concern	Medium
Common Buzzard	Least Concern	Least Concern	Medium
Egyptian Goose	Least Concern	Least Concern	High
Greater Kestrel	Least Concern	Least Concern	Medium
Grey Heron	Least Concern	Least Concern	High
Hadada Ibis	Least Concern	Least Concern	High
Hamerkop	Least Concern	Least Concern	Medium
Helmeted Guineafowl	Least Concern	Least Concern	High
Jackal Buzzard	Least Concern	Least Concern	Medium
Lanner Falcon	Least Concern	Vulnerable	Medium
Long-crested Eagle	Least Concern	Least Concern	Medium
Pied Crow	Least Concern	Least Concern	High
Reed Cormorant	Least Concern	Least Concern	High
Rock Kestrel	Least Concern	Least Concern	Medium
Secretarybird	Endangered	Vulnerable	Medium
Spotted Eagle-Owl	Least Concern	Least Concern	Medium
Spur-winged Goose	Least Concern	Least Concern	High
Western Cattle Egret	Least Concern	Least Concern	High
White Stork	Least Concern	Least Concern	Medium
White-breasted Cormorant	Least Concern	Least Concern	High
African Fish Eagle	Least Concern	Least Concern	Low
Red-footed Falcon	Near Threatened	Near Threatened	Low
Western Barn Owl	Least Concern	Least Concern	Low

PRIORITY SPECIES

A total of 189 species could potentially occur within the broader area where the project site is located (see Appendix E). Of these, 66 are classified as powerline priority species , of which fifty-two (52) are considered to regularly occur in the development PAOI, with thirty-seven (37) such species having been recorded during the field surveys.

Fifteen Red Data List species are associated with the broader area. Three Red List species have a medium to high probability of occurrence within the PAOI - Blue Korhaan, Greater Flamingo, and Secretarybird. The remaining twelve Red List species have a low probability of occurrence – African Marsh Harrier, Black-winged Pratincole, Blue Crane, Caspian Tern, Curlew Sandpiper, European Roller, Greater Painted-snipe, Lanner Falcon, Maccoa Duck, Pallid Harrier, Red-footed Falcon, and Sentinel Rock Thrush.

Table 6-23 lists the possibility of priority species occurring in the study area and the potential long-term impacts.

Table 6-23: Powerline priority species which could occur in the broader area (Global and Regional (South African) Red List status: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least concern. Occurrence likelihood: L = Low, M = Medium, H = High)

SPECIES NAME	SCIENTIFIC NAME	GLOBAL STATUS	REGIONAL STATUS	FULL PROTOCOL	AD HOC PROTOCOL	RECORDED DURING MONITORING	OCCURRENCE LIKELIHOOD	GRASSLAND	DRAINAGE LINES AND WETLANDS	DAMS AND PANS	AGRICULTURE	ALIEN TREES	GRID - HABITAT TRANSFORMATION	GRID - DISTURBANCE (BREEDING)	GRID - SUBSTATION ELECTROCUTIONS	GRID – COLLISION HV LINES
African Black Duck	*Anas sparsa*	LC	LC	8.54	0.00		M		x	x						x
African Darter	*Anhinga rufa*	LC	LC	26.83	11.76	x	H		x	x		x				x
African Fish Eagle	*Haliaeetus vocifer*	LC	LC	1.22	0.00		L			x		x		x	x	
African Marsh Harrier	*Circus ranivorus*	LC	EN	1.22	0.00		L		x					x		
African Openbill	*Anastomus lamelligerus*	LC	LC	1.22	0.00		L		x	x						x
African Sacred Ibis	*Threskiornis aethiopicus*	LC	LC	63.41	23.53	x	H	x	x	x	x	x			x	x
African Spoonbill	*Platalea alba*	LC	LC	21.95	5.88	x	H		x	x		x				x
African Swamphen	*Porphyrio madagascariensis*	LC	LC	6.10	0.00		M		x							
Amur Falcon	*Falco amurensis*	LC	LC	34.15	2.94	x	H	x			x	x	x		x	
Black Heron	*Egretta ardesiaca*	LC	LC	3.66	2.94		L		x	x						x
Black Sparrowhawk	*Accipiter melanoleucus*	LC	LC	0.00	0.00	x	M					x		x	x	
Black-crowned Night Heron	*Nycticorax nycticorax*	LC	LC	1.22	0.00		L		x							x
Black-headed Heron	*Ardea melanocephala*	LC	LC	81.71	23.53	x	H	x			x	x	x	x	x	x
Black-winged Kite	*Elanus caeruleus*	LC	LC	70.73	23.53	x	H	x			x	x	x	x	x	
Blue Crane	*Grus paradisea*	VU	NT	1.22	2.94	x	M	x	x	x	x		x	x		x
Blue Korhaan	*Eupodotis caerulescens*	NT	LC	17.07	2.94	x	M	x					x	x		x
Blue-billed Teal	*Spatula hottentota*	LC	LC	1.22	0.00		L		x	x						x

SPECIES NAME	SCIENTIFIC NAME	GLOBAL STATUS	REGIONAL STATUS	FULL PROTOCOL	AD HOC PROTOCOL	RECORDED DURING MONITORING	OCCURRENCE LIKELIHOOD	GRASSLAND	DRAINAGE LINES AND WETLANDS	DAMS AND PANS	AGRICULTURE	ALIEN TREES	GRID - HABITAT TRANSFORMATION	GRID - DISTURBANCE (BREEDING)	GRID - SUBSTATION ELECTROCUTIONS	GRID – COLLISION HV LINES
Cape Crow	*Corvus capensis*	LC	LC	13.41	5.88	x	M	x			x	x		x	x	
Cape Shoveler	*Spatula smithii*	LC	LC	29.27	11.76	x	H		x	x						x
Cape Teal	*Anas capensis*	LC	LC	2.44	0.00		L		x	x						x
Common Buzzard	*Buteo buteo*	LC	LC	8.54	0.00	x	M	x			x	x	x		x	
Common Moorhen	*Gallinula chloropus*	LC	LC	36.59	11.76		H		x	x						
Egyptian Goose	*Alopochen aegyptiaca*	LC	LC	73.17	38.24	x	H	x	x	x	x	x		x	x	x
Fulvous Whistling Duck	*Dendrocygna bicolor*	LC	LC	2.44	0.00		L		x							x
Glossy Ibis	*Plegadis falcinellus*	LC	LC	36.59	5.88		H		x	x						x
Goliath Heron	*Ardea goliath*	LC	LC	6.10	2.94		M		x	x				x		x
Great Crested Grebe	*Podiceps cristatus*	LC	LC	2.44	0.00		L		x	x						x
Great Egret	*Ardea alba*	LC	LC	6.10	2.94		M		x	x						x
Greater Flamingo	*Phoenicopterus roseus*	LC	NT	4.88	5.88	x	M			x						x
Greater Kestrel	*Falco rupicoloides*	LC	LC	6.10	2.94	x	M	x			x	x	x	x	x	
Grey Heron	*Ardea cinerea*	LC	LC	34.15	14.71	x	H		x	x		x		x		x
Hadada Ibis	*Bostrychia hagedash*	LC	LC	79.27	35.29	x	H	x	x		x	x		x	x	x
Hamerkop	*Scopus umbretta*	LC	LC	9.76	0.00		M		x	x		x		x		x
Helmeted Guineafowl	*Numida meleagris*	LC	LC	69.51	20.59	x	H	x			x	x	x	x	x	
Intermediate Egret	*Ardea intermedia*	LC	LC	23.17	2.94		H		x	x						x
Jackal Buzzard	*Buteo rufofuscus*	LC	LC	4.88	0.00		M	x			x	x	x	x	x	

SPECIES NAME	SCIENTIFIC NAME	GLOBAL STATUS	REGIONAL STATUS	FULL PROTOCOL	AD HOC PROTOCOL	RECORDED DURING MONITORING	OCCURRENCE LIKELIHOOD	GRASSLAND	DRAINAGE LINES AND WETLANDS	DAMS AND PANS	AGRICULTURE	ALIEN TREES	GRID - HABITAT TRANSFORMATION	GRID - DISTURBANCE (BREEDING)	GRID - SUBSTATION ELECTROCUTIONS	GRID – COLLISION HV LINES
Knob-billed Duck	*Sarkidiornis melanotos*	LC	LC	1.22	0.00		L		x	x						x
Lanner Falcon	*Falco biarmicus*	LC	VU	4.88	0.00	x	M	x			x	x	x	x	x	
Little Egret	*Egretta garzetta*	LC	LC	23.17	14.71	x	H		x	x						x
Little Grebe	*Tachybaptus ruficollis*	LC	LC	64.63	17.65	x	H			x						x
Long-crested Eagle	*Lophaetus occipitalis*	LC	LC	3.66	0.00		M	x	x			x	x	x	x	
Maccoa Duck	*Oxyura maccoa*	VU	NT	3.66	0.00		L		x	x						x
Mallard	*Anas platyrhynchos*	LC	LC	8.54	2.94		M		x	x						x
Marsh Owl	*Asio capensis*	LC	LC	24.39	2.94	x	H	x	x		x		x	x	x	x
Northern Black Korhaan	*Afrotis afraoides*	LC	LC	0.00	0.00	x	M	x					x	x		x
Pallid Harrier	*Circus macrourus*	NT	NT	1.22	0.00		M	x					x		x	
Pied Crow	*Corvus albus*	LC	LC	31.71	2.94	x	H	x			x	x		x	x	
Purple Heron	*Ardea purpurea*	LC	LC	10.98	0.00		M		x	x						x
Red-billed Teal	*Anas erythrorhyncha*	LC	LC	35.37	2.94	x	H		x	x						x
Red-footed Falcon	*Falco vespertinus*	NT	NT	1.22	0.00		L	x			x	x	x		x	
Red-knobbed Coot	*Fulica cristata*	LC	LC	74.39	29.41	x	H			x						x
Reed Cormorant	*Microcarbo africanus*	LC	LC	75.61	20.59	x	H		x	x		x				x
Rock Kestrel	*Falco rupicolus*	LC	LC	2.44	2.94	x	M	x			x	x	x	x	x	
Secretarybird	*Sagittarius serpentarius*	EN	VU	8.54	0.00	x	M	x				x	x	x		x
South African Shelduck	*Tadorna cana*	LC	LC	8.54	2.94	x	M		x	x						x

SPECIES NAME	SCIENTIFIC NAME	GLOBAL STATUS	REGIONAL STATUS	FULL PROTOCOL	AD HOC PROTOCOL	RECORDED DURING MONITORING	OCCURRENCE LIKELIHOOD	GRASSLAND	DRAINAGE LINES AND WETLANDS	DAMS AND PANS	AGRICULTURE	ALIEN TREES	GRID - HABITAT TRANSFORMATION	GRID - DISTURBANCE (BREEDING)	GRID - SUBSTATION ELECTROCUTIONS	GRID – COLLISION HV LINES
Southern Pochard	*Netta erythrophthalma*	LC	LC	12.20	0.00	x	M		x	x						x
Spotted Eagle-Owl	*Bubo africanus*	LC	LC	6.10	0.00	x	M	x			x	x	x	x	x	x
Spur-winged Goose	*Plectropterus gambensis*	LC	LC	40.24	8.82	x	H	x	x	x	x	x			x	x
Squacco Heron	*Ardeola ralloides*	LC	LC	7.32	0.00		M		x	x						x
Western Barn Owl	*Tyto alba*	LC	LC	0.00	2.94		L	x			x	x	x	x	x	x
Western Cattle Egret	*Bubulcus ibis*	LC	LC	70.73	23.53	x	H	x			x	x			x	x
White Stork	*Ciconia ciconia*	LC	LC	3.66	0.00	x	M	x				x				x
White-backed Duck	*Thalassornis leuconotus*	LC	LC	3.66	0.00		L		x	x						x
White-breasted Cormorant	*Phalacrocorax lucidus*	LC	LC	25.61	11.76	x	H		x	x		x				x
White-faced Whistling Duck	*Dendrocygna viduata*	LC	LC	14.63	0.00		H		x	x						x
Yellow-billed Duck	*Anas undulata*	LC	LC	70.73	26.47	x	H		x	x						x

FIELD SURVEYS

A total of 37 powerline priority species were observed during pre-construction monitoring at the proposed Mukondeleli WEF, which also included the grid study area (**Table 6-24**).

Table 6-24: Powerline priority species observed during preconstruction monitoring at the Mukondeleli Grid Connection development area.

SPECIES NAME	SCIENTIFIC NAME
African Darter	*Anhinga rufa*
African Sacred Ibis	*Threskiornis aethiopicus*
African Spoonbill	*Platalea alba*
Amur Falcon	*Falco amurensis*
Black Sparrowhawk	*Accipiter melanoleucus*
Black-headed Heron	*Ardea melanocephala*
Black-winged Kite	*Elanus caeruleus*
Blue Crane	*Grus paradisea*
Blue Korhaan	*Eupodotis caerulescens*
Cape Crow	*Corvus capensis*
Cape Shoveler	*Spatula smithii*
Common Buzzard	*Buteo buteo*
Egyptian Goose	*Alopochen aegyptiaca*
Greater Flamingo	*Phoenicopterus roseus*
Greater Kestrel	*Falco rupicoloides*
Grey Heron	*Ardea cinerea*
Hadada Ibis	*Bostrychia hagedash*
Helmeted Guineafowl	*Numida meleagris*
Lanner Falcon	*Falco biarmicus*
Little Egret	*Egretta garzetta*
Little Grebe	*Tachybaptus ruficollis*
Marsh Owl	*Asio capensis*
Northern Black Korhaan	*Afrotis afraoides*
Pied Crow	*Corvus albus*
Red-billed Teal	*Anas erythrorhyncha*
Red-knobbed Coot	*Fulica cristata*
Reed Cormorant	*Microcarbo africanus*
Rock Kestrel	*Falco rupicolus*
Secretarybird	*Sagittarius serpentarius*
South African Shelduck	*Tadorna cana*

SPECIES NAME	SCIENTIFIC NAME
Southern Pochard	*Netta erythrophthalma*
Spotted Eagle-Owl	*Bubo africanus*
Spur-winged Goose	*Plectropterus gambensis*
Western Cattle Egret	*Bubulcus ibis*
White Stork	*Ciconia ciconia*
White-breasted Cormorant	*Phalacrocorax lucidus*
Yellow-billed Duck	*Anas undulata*

6.3 SOCIAL ENVIRONMENT

6.3.1 LAND USE

According to the South African National Land Cover dataset (Geoterraimage 2020), much of the visual assessment area is classified as “Cultivated Land” interspersed with significant areas of “Grassland”. Small tracts of forested land and numerous water bodies are scattered throughout the study area (**Figure 6-15**).

Commercial agriculture is the dominant activity in the study area, with the main focus being maize cultivation with some limited livestock and game farming. There are multiple farm portions in the study area, resulting in a relatively moderate density of rural settlement with many scattered farmsteads in evidence. Built form in much of the study area comprises farmsteads, ancillary farm buildings and workers’ dwellings, gravel access roads, power and telephone lines and fences.

High levels of human influence are however visible in the northern half of the study area. The towns of Embalenhle and Secunda lie on the northern boundary of the study area and the peri-urban areas extending into the study area are dominated by industrial / mining activity. In addition, the Sasol Secunda synthetic fuel plant is occupies a large tract of land in the northern sector of the study area, and this facility together with infrastructure related to the supply and storage of coal and electrical infrastructure has resulted in significant transformation in the landscape. Associated with the Sasol plant is the nearby Riaan Rademan Training Academy and adjacent electrical substation, contributing further to the overall transformation of the landscape in this area. In addition, mining and quarrying activity, including the Bosjesspruit Mine and associated infrastructure in the areas to the north-east of the Mukondeleli EGI project area have further degraded the visual landscape.

To the south of the Mukondeleli combined grid assessment corridor is the small town of Charl Cilliers forming a significant area of transformation in the landscape.

Other evidence of human influence in the area includes mining activity in the central sector of the study area with some associated service industry as well as road, rail, telecommunications and electricity infrastructure.

The predominance of cultivated land in conjunction with the remaining natural grassland cover across much of the study area would give the viewer the general impression of a largely rural / pastoral setting. Thus, the proposed Mukondeleli powerline development could potentially alter the visual character and contrast with the typical land use and/or pattern and form of human elements present across much of the study area.

In this instance however, high levels of human transformation and visual degradation are evident in the study area where urban/industrial, peri-urban development and mining activity dominate the landscape in the northern half of the study area. In addition, roads, railways and coal conveyors have further degraded the visual character of the study area to some degree, and this factor in conjunction with the presence of an extensive network of high voltage powerlines in the study area will reduce the level of contrast of the proposed development.

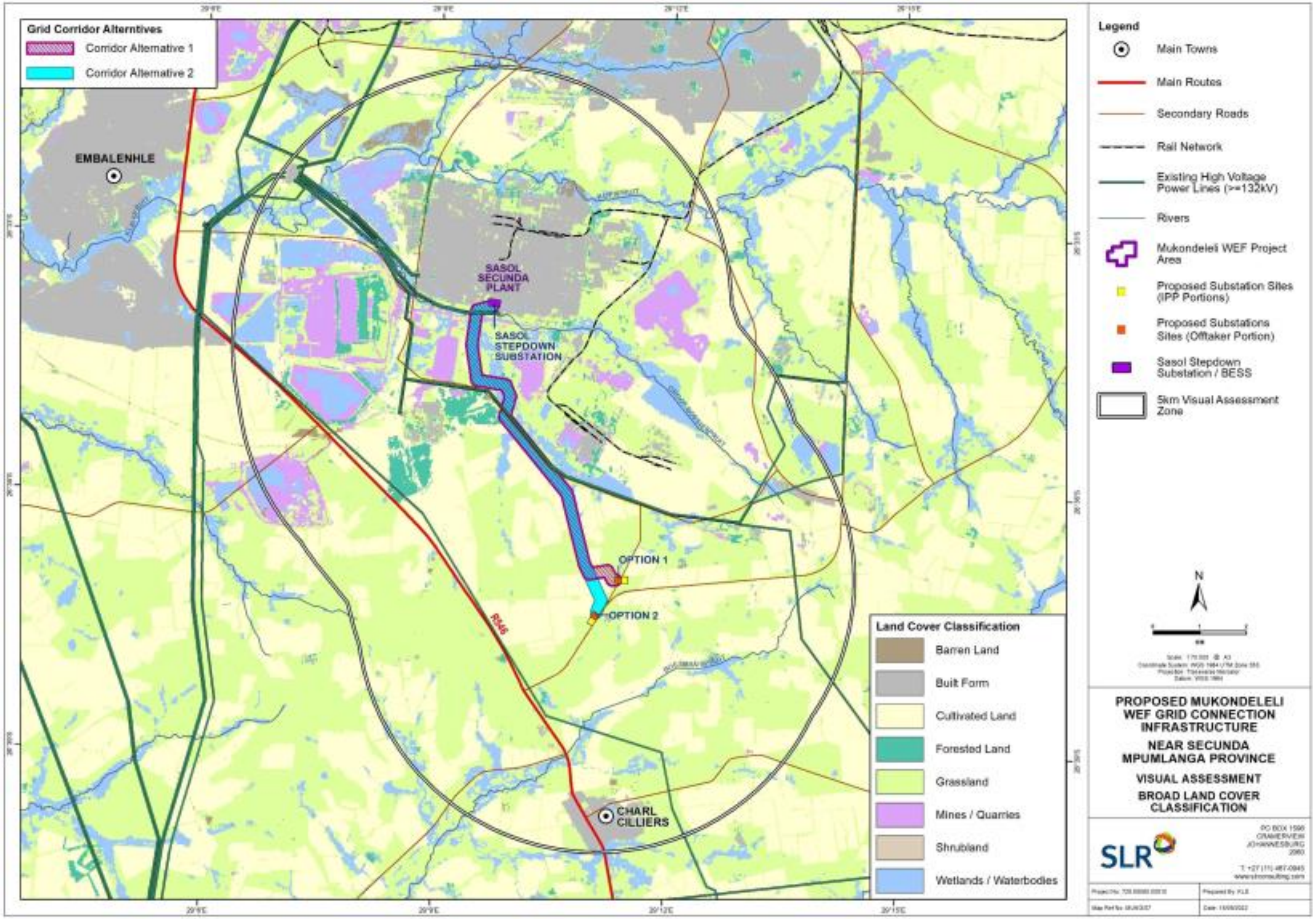


Figure 6-15: Mukondeleli Powerline Corridor Land Cover Classification

6.3.2 HERITAGE AND CULTURAL RESOURCES

PALAEONTOLOGY

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for development mainly is in the Jurassic dolerite but there are a few outcrops of the Vryheid Formation.

The **Vryheid Formation** lies on the uneven topography of pre-Karoo or Dwyka Group rocks in the northern and northwestern margins, but lies directly on the Pietermaritzburg Formation in the central and eastern part. The lithofacies show a number of upward-coarsening cycles, some very thick, and they are essentially deltaic in origin. There are also delta-front deposits, evidence of delta switching, and fluvial deposits with associated meandering rivers, braided streams, back swamps or interfluves and abandoned channels (Cadle et al., 1993; Cairncross, 1990; 2001; Johnson et al., 2006). Coal seams originated where peat swamps developed on broad abandoned alluvial plains, and less commonly in the backswamps or interfluves. Most of the economically important coal seams occur in the fluvial successions (ibid). In the east (Mpumalanga and northern KwaZulu Natal), the Vryheid formation can be subdivided into a lower fluvial-dominated deltaic interval, a middle fluvial interval, and an upper fluvial-dominated deltaic interval again (Taverner-Smith et al., 1988).

Since dolerite is an igneous (volcanic) rock, it does not preserve any fossils. In fact, the dolerite usually destroys any fossils in its near vicinity that were present in the sediments through which it has intruded.

The SAHRIS Palaeosensitivity Map shows the site to be of zero sensitivity in the south (grey shading) and variably moderate (green) or very high (red) in the centre and north (**Figure 6-16**). Due to the sandy substrate and generally dense vegetation covering throughout the study area, a desktop palaeontological study was carried out.

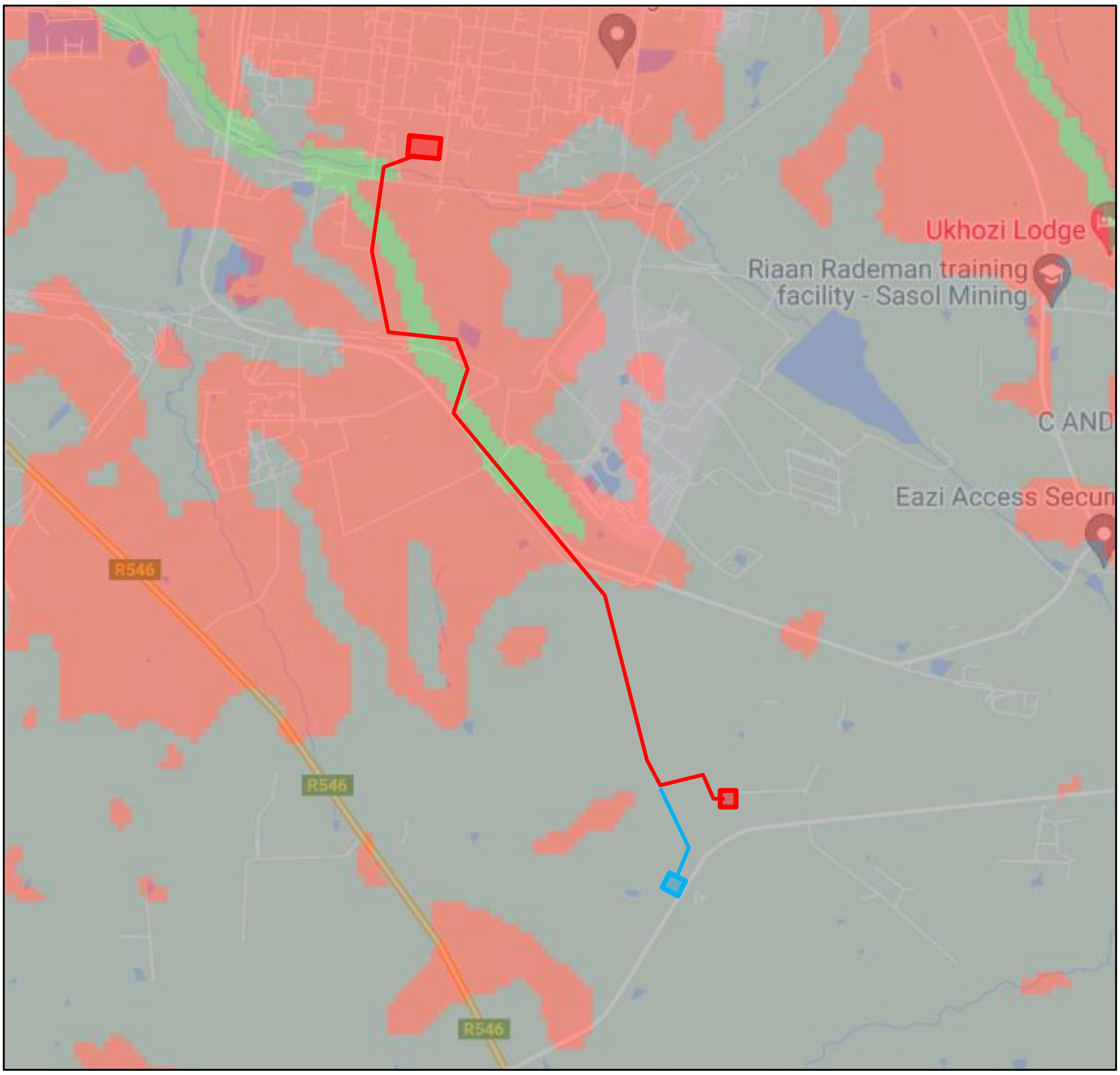


Figure 6-16: *Extract from the SAHRIS Palaeosensitivity Map showing the site to be of zero to very high sensitivity*

ARCHAEOLOGY

Mpumalanga does not include an extensive Early Stone Age record (Esterhuysen & Smith 2007). Although the Middle and Late Stone Age periods have not yet been comprehensively studied, evidence for these periods has been excavated from Bushman Rock Shelter in the Ohrigstad District (Esterhuysen & Smith 2007) and it is known that San communities lived near Lake Chrissie as recently as the 1950s (e.g., Schlebusch *et al.* 2016).

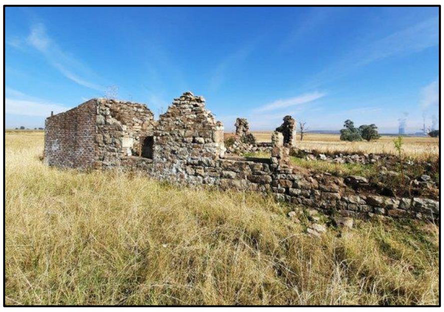
The archaeological remains of Iron Age settlements are more frequently found in the province. The archaeology of farming communities of southern Africa encompasses three phases. The Early Iron Age (200-900 AD) represents the arrival of Bantu-speaking farmers in southern Africa. Living in sedentary settlements often located next to rivers, these farmers cultivated sorghum, beans, and cowpeas, and kept livestock. The Middle Iron Age (900-1300 AD) is mostly confined to the Limpopo Province with the most notable site in southern Africa located in the Limpopo Valley; Mapungubwe Hill probably represents the earliest 'state' in this region. The Late Iron Age (1300-1840s AD) marks the arrival and spread of ancestral Eastern Bantu-speaking Nguni and Sotho-Tswana communities into southern Africa. The location of Late Iron Age settlements is usually on or near hilltops for defensive purposes. The Late Iron Age as an archaeological period ended by 1840 AD, when the Mfecane caused major socio-political disruptions in southern Africa (Mitchell 2002; Huffman 2007).

Dates from Early Iron Age sites indicated that by the beginning of the 5th century AD Bantu-speaking farmers had settled in the Mpumalanga lowveld. Subsequently, farmers continued to move into and between the lowveld and highveld of Mpumalanga. By 1500 AD the escarpment was populated by chiefdoms, including Pedi and Bokoni communities. These chiefdoms would have had trade relations with Ndundza, Swazi and Zulu kingdoms, exchanging salt, cattle and metals as evidenced by the archaeological record (Esterhuysen & Smith 2007; Delius *et al.* 2012).

Four (4) archaeological resources were recorded in the study area. These are listed in **Table 6-25**.

The sites recorded are all stone-walled sites assumed to be the dwellings and associated structures of white farmers. Most likely have their roots in the 19th century but would have fallen into disuse during the 20th century. Historical buildings were often purposefully demolished so that the stones could be reused elsewhere on the farms and this may explain the very limited rubble seen at some sites. It is possible that abandoned houses may have been used by farm labourers before their eventual demolition and, as such, the possibility of still-born babies having been buried there must be considered. The chances of this happening are, however, very small and such remains would likely not be findable during earthmoving.

Table 6-25: List of heritage finds recorded during the field survey.

WAYPOINT	LOCATION	NATURE	GRADE
MD007	26° 36’ 53.2908” S 29° 10’ 57.9253” E 	Archaeological – stone features Large ruined historical farmstead complex. The complex includes multiple degraded structures such as the farmhouse, a small rondavel, a small brick structure and a broken-down cattle handling area. The main farmhouse is built from stone and cement and includes multiple rooms with brick and cement garage that seems to be a recent addition to the main house ruin. The rondavel is also built from red bricks. The main house is about 20 by 30 m in size, while the overall farm complex measures some 100 m by 100 m.	GPA
MD008	26° 36’ 34.8805” S 29° 10’ 44.8319” E 	Possible grave Two possible stone packed graves lying about 25 m northwest of the ruins at MD009. The features are very degraded and difficult to define. Sisal bush growing on top of the site. The two mounds lie in an area of about 4 m by 4 m. There is no interpretive evidence to be gained from the historical aerial photography shown under MD009. Therefore, for precautionary reasons they are given a grading of IIIA	IIIA

WAYPOINT	LOCATION	NATURE	GRADE
MD009	26° 36' 35.2692" S 29° 10' 45.5449" E 	Archaeological – stone features Remains of a demolished sandstone ruin. Various small foundations and demolished features are situated within close proximity of the main ruin. The main ruin is about 11 m by 6 m, while the larger area encompassing all demolished features is about 50 m by 50 m	GPB
MD014	26° 37' 22.7600" S 29° 11' 22.8600" E 	Archaeological – stone features MD014 was identified from aerial photography to the southwest of the southern end of the powerline. All visible features have been buffered by 50 m. The site appears to be an abandoned farmstead	GPA

HISTORICAL ASPECTS AND THE BUILT ENVIRONMENT

During the mid-17th century, the Dutch East India Company established a trading post at modern-day Cape Town. Simultaneously, the Portuguese colonised Lourenço Marques (Maputo), Mozambique. As such, the Mpumalanga landscape became a thoroughfare for local and foreign traders. However, the increasing intensity of interaction among indigenous peoples and European merchants led to intensified competition over control of trade routes and accumulating wealth. Consequently, political centralisation led to warfare and population displacement (Derricourt & Evers 1973; Esterhuysen & Smith 2007; Delius *et al.* 2012).

By the 1830s, Dutch-speaking farmers started to migrate from modern-day Cape Town towards the interior regions of South Africa. Dutch-speaking migrants entering the region were confronted with existing tension between local groups due to the ongoing Mfecane, trade conflicts, and pressure from foreign merchants. Motivated to improve their own economic position within the area, more conflict between the Dutch, Sotho-Tswana and Nguni speaking communities started to take place (Giliomee & Mbenga 2007). Ultimately, Dutch-speaking farmers did settle in Mpumalanga and neighbouring provinces.

During the 1850s coalfields were already being exploited. Coal served a variety of purposes, as it still does today. From powering steam trains, ships, furnaces for smelting metals, it was also utilised within a domestic context, to heat up space and cook food. Since the discovery of diamonds and gold the industrial demand for coal increased significantly. Lucrative mining continued until the onset of the South African War of 1899 -1902 when the workforce joined the war effort, and, as usual during wartime, railways and infrastructure were destroyed. Following the end of the South African War, activities within the South African Union (formed in 1910) were aimed at stabilising the economy by focusing on agriculture and coal mining. However, post-war socio-economic and political crises, especially after World War I (1914-1918) had a profound economic and political impact on the South African coal industry and mine workers (Giliomee & Mbenga 2007). Due to the relative economic and political stability after World War II (1939-1945), mining towns were established and coal mining continued. Today coal is still an integral part of the South African economy, used for the generation of electricity, synthetic fuels, and petrochemical products (Mathu & Chinomona 2013).

The discovery of coal, gold and diamonds during the mid-19th century led to a variety of socio-economic changes within South Africa. Since the discovery of mineral wealth, the new wage-economy and migrant labour systems contributed to the demise of traditional homestead economies and social organisation. In addition, competition for resources led to conflict, political upheavals and ultimately warfare (e.g., Crush & Soutter 1999; Delius 2014).

The province of Mpumalanga has the most collieries and the largest coalfield. The study area is situated near the town of Secunda within the Govan Mbeki Local Municipality. The town was established in 1976 by Sasol Limited, on the farm Goede Hoop (Schirmer 2007; Mathu & Chinomona 2013). Working a short way to the northeast of the present study area, Hardwick *et al.* (2019) recorded only relatively recent graves with the oldest gravestone dating to 1894 A and indicating colonial use of the landscape to not extend very far back.

The site itself is an agricultural landscape, the overall character in the southern approximately 3 km has not changed over the last 67 years but the northern approximately 4 km is massively different with extensive industrial development having occurred. Other specific changes noticeable are as follows:

- The road through the centre of the study area has been added;
- The layout and ploughing patterns of many of the agricultural fields have changed; and
- A new field has been cultivated adjacent to the Alternative 2 Substation site.

It is evident from the historical archaeological finds that the agricultural landscape is historical, but many structures in the area seem to be relatively modern. No doubt a number of existing houses are older than 60 years but none were visited during the survey. No buildings, historical or otherwise, will be directly impacted and no other historical sites are anticipated to occur in the vicinity of the proposed corridor.

CULTURAL LANDSCAPE

Cultural landscapes are the product of the interactions between humans and nature in a particular area. Sauer (1925) defined them thus: “The cultural landscape is fashioned from a natural landscape by a cultural group. Culture is the agent, the natural area is the medium, the cultural landscape the result”.

The historical landscape is an agricultural one characterised by grazing lands (grass) and arable lands (planted with crops). The landscape is extensive and is currently punctuated by towns and coal mines with the northern part of the present corridor being strongly dominated by the Sasol facility. It is not a particularly sensitive cultural landscape with most of its development having taken place during the 20th century. Locally, it is compromised by the very large Sasol facility located at the north end of the corridor, and several coal mines in the surrounding landscape.

There are no scenic routes in the area and the R546 that runs from northwest to southeast some 2.8 km southwest of the corridor is a relatively minor road that is highly unlikely to be considered a scenic route.

STATEMENT OF SIGNIFICANCE AND PROVISIONAL GRADING

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ‘‘cultural significance’’ means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. The reasons that a place may have cultural significance are outlined in Section 3(3) of the NHRA.

The archaeological resources are deemed to have low to medium cultural significance at the local level for their scientific value and can be variably graded from GPA to GPC.

Graves are deemed to have high cultural significance at the local level for their social value. They are allocated a grade of IIIA. Possible graves are included here for precautionary reasons.

The cultural landscape is largely an agricultural landscape with low aesthetic value due to the visual intrusions from the nearby Sasol facility and coal mines which add an industrial layer. It is rated as having low cultural significance at the local level.

Figure 6-17 and **Figure 6-18** show a grade map with all resources indicated with 50 m buffers.

Figure 6-17: Grade map of the study area showing the locations of all sites found close to the corridor. They are coloured as follows: Graded IIIA = dark red, GPA = orange and GPB = yellow

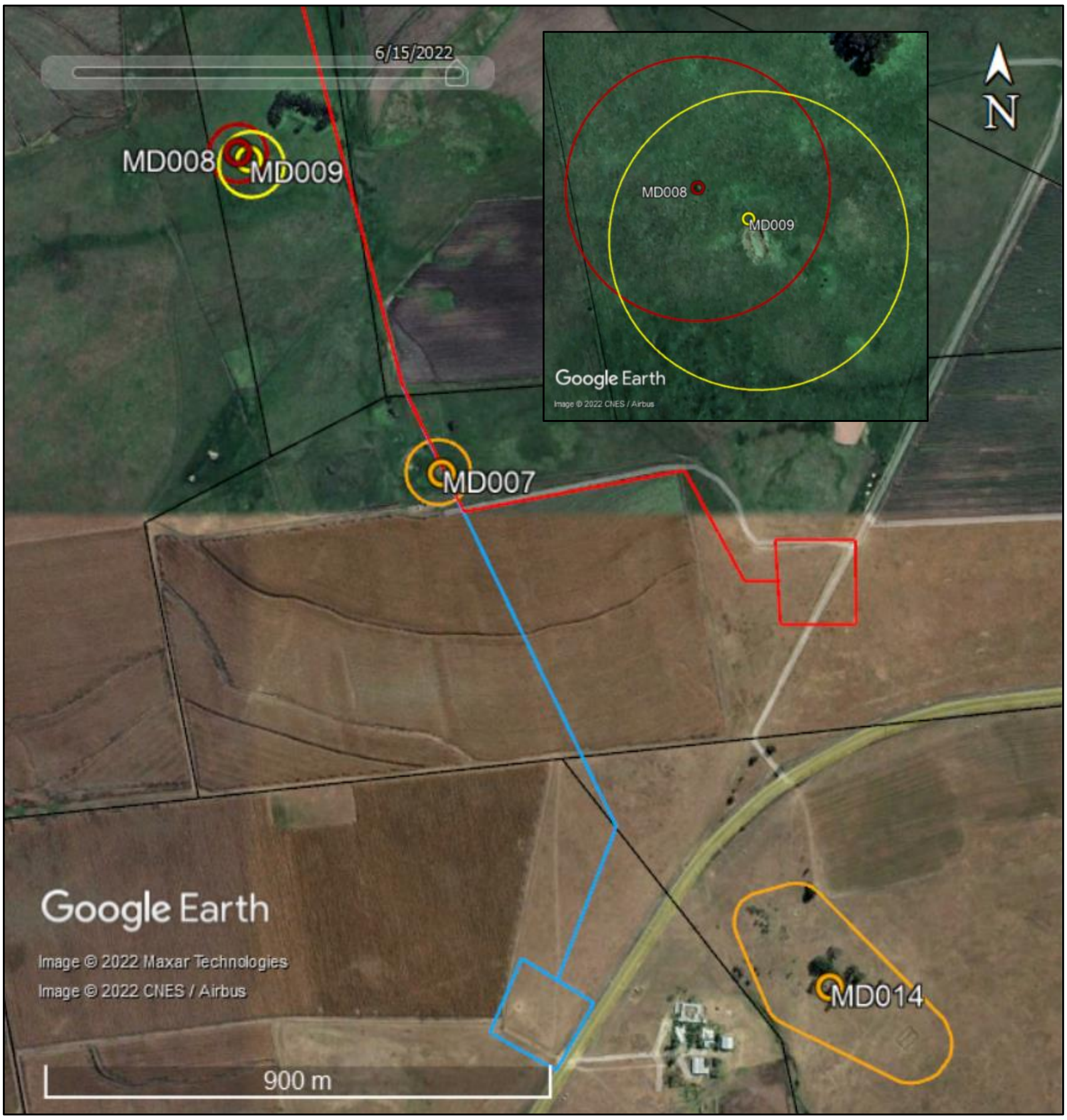


Figure 6-18: Grade map of the study area showing the locations of all sites found close to the corridor. They are coloured as follows: Graded IIIA = dark red, GPA = orange and GPB = yellow

6.3.3 VISUAL CHARATER AND SENSITIVITY

VISUAL CHARACTER AND CULTURAL VALUE

The physical and land use-related characteristics of the study area as described above contribute to its overall visual character. Visual character largely depends on the level of change or transformation from a natural baseline in which there is little evidence of human transformation of the landscape. Varying degrees of human transformation of a landscape would engender differing visual characteristics to that landscape, with a highly modified urban or industrial landscape being at the opposite end of the scale to a largely natural, undisturbed landscape. Visual character is also influenced by the presence of built infrastructure including buildings, roads and other objects such as telephone or electrical infrastructure. The visual character of an area largely determines the sense of place relevant to the area. This is the unique quality or character of a place, whether natural, rural or urban which results in a uniqueness, distinctiveness or strong identity.

The predominant land use in the area (maize cultivation) has significantly transformed the natural landscape across much of the study area. In addition, the landscape becomes progressively more transformed towards the northern sector of the study area where the towns of Embalenhle and Secunda, the Sasol Secunda fuel plant and mining activities have resulted in a high degree of visual degradation. Further transformation is evident to the south where the town of Charl Cilliers straddles the R546 Main Road. The more industrial and urbanised character of the landscape is an important factor in this context, as the introduction of the proposed powerline would result in less visual contrast where other anthropogenic elements are already present, especially where the scale of those elements is similar to that of the proposed development.

The scenic quality of the landscape is also an important factor that contributes to the visual character or inherent sense of place. Visual appeal is often associated with unique natural features or distinct variations in form. As such, the pastoral landscape and rolling hills in parts of the study area are important features that could increase the visual appeal and visual interest in the area.

Cultural landscapes are becoming increasingly important concepts in terms of the preservation and management of rural and urban settings across the world. The concept of ‘cultural landscape’ is a way of looking at a place that focuses on the relationship between human activity and the biophysical environment (Breedlove, 2002). In this instance, the rural / pastoral landscape represents how the environment has shaped the predominant land use and economic activity practiced in the area, as well as the patterns of human habitation and interaction.

Considering this, it is important to assess whether the introduction of a powerline and associated infrastructure into the study area would be a degrading factor in the context of the prevailing character of the cultural landscape. Broadly speaking, visual impacts on the cultural landscape in the area around the proposed development would be reduced by the fact that the visual character in much of the area has been significantly transformed and degraded by urban/industrial, mining and infrastructural development.

VISUAL ABSORPTION CAPACITY

Visual absorption capacity is the ability of the landscape to absorb a new development without any significant change in the visual character and quality of the landscape. The level of absorption capacity is largely based on the physical characteristics of the landscape (topography and vegetation cover) and the level of transformation present in the landscape.

Although the undulating topography in the study area and the areas of cultivation and grassland would reduce the visual absorption capacity, this would be offset considerably by the presence of urban/industrial, mining and infrastructural development in the vicinity of the proposed Mukondeleli EGI project.

Visual absorption capacity in the study area is therefore rated as MODERATE.

SENSITIVE VISUAL RECEPTOR LOCATIONS

A sensitive visual receptor location is defined as a location from where receptors would potentially be impacted by a proposed development. Adverse impacts often arise where a new development is seen as an intrusion that alters the visual character of the area and affects the ‘sense of place’. The degree of visual impact experienced will however vary from one receptor to another, depending on the viewer’s perception.

A distinction must be made between a receptor location and a sensitive receptor location. A receptor location is a site from where the proposed development may be visible, but the receptor may not necessarily be adversely affected by any visual intrusion associated with the development. Less sensitive receptor locations include locations of commercial activities and certain movement corridors, such as roads that are not tourism routes. More sensitive receptor locations typically include sites that are likely to be adversely affected by the visual intrusion of the proposed development. They include tourism facilities, scenic sites and residential dwellings in natural settings.

Preliminary desktop assessment did not identify any formal protected areas or leisure-based tourism activities in the study area for the proposed Mukondeleli EGI. The desktop assessment did however identify multiple farmsteads and residences within the study area. While these homesteads and residences could be considered to be receptors, not all of them would be sensitive to the proposed development and given the number of farmsteads, it was not possible to confirm the presence of receptors at all the identified locations. Notwithstanding these limitations, all the identified receptor locations were assessed as part of the VIA as they are still regarded as being potentially sensitive to the visual impacts associated with the proposed development. None of these receptor locations was found to be sensitive.

Although most of the receptor locations are believed to be farmsteads, they are regarded as potentially sensitive visual receptors as the proposed development could potentially alter natural or semi-natural vistas experienced from these locations. At this stage however, local sentiments towards the proposed development are not known.

It was noted that residential areas within the town of Charl Cilliers are located within the Mukondeleli EGI study area. While these could be considered as receptors, they are not considered to be sensitive due to their location within built-up, heavily transformed areas. Residential areas within the towns of Embalenhle and Secunda are outside the study area.

In many cases, roads along which people travel, are regarded as sensitive receptors. The primary thoroughfare in the study area is the R546 Main Road which traverses the eastern sector of the study area, linking Standerton to the south with the N17 National Route and Kinross to the North. The section of this road traversing the study area is not however considered part of a designated scenic route, although the route is an important link and is likely to be utilised, to some extent, by tourists en route to other parts of Mpumalanga Province. As a result, it is considered to be a potentially sensitive receptor road – i.e, a road being used by motorists who may object to the potential visual intrusion of the proposed new powerline infrastructure.

The other thoroughfares in the study area are primarily used as local access roads and do not form part of any scenic tourist routes. These roads are not specifically valued or utilised for their scenic or tourism potential and are therefore not regarded as visually sensitive.

The potentially sensitive visual receptor locations identified within the study area for the proposed Mukondeleli EGI are indicated in **Figure 6-19**.

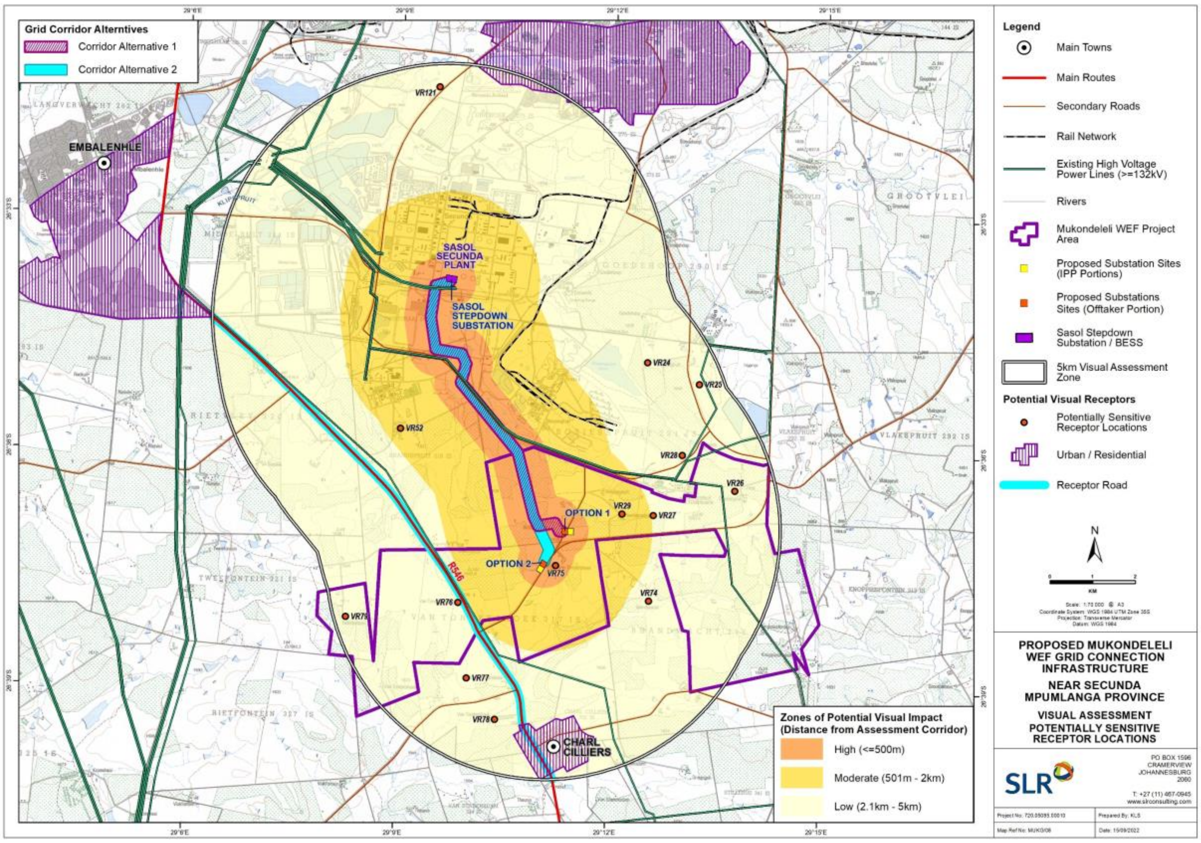


Figure 6-19: Potentially Sensitive Receptor Locations

NIGHT-TIME VISUAL BASELINE

The visual impact of lighting on the nightscape is largely dependent on the existing lighting present in the surrounding area at night. The night scene in areas where there are numerous light sources will be visually degraded by the existing light pollution and therefore additional light sources are unlikely to have a significant impact on the nightscape. In contrast, introducing new light sources into a relatively dark night sky will impact on the visual quality of the area at night. It is thus important to identify a night-time visual baseline before exploring the potential visual impact of the proposed development at night.

The towns of Embalenhle and Secunda, located just outside the north-eastern and north-western boundary of the Mkondeleli EGI study area, together with the rural town of Charl Cilliers to the south, are the main sources of light within the broader area. The towns, in conjunction with the Sasol Secunda fuel plant and mining activities are expected to have a significant impact on the night scene in the study area.

Other light sources in the broader area would largely emanate from the many farmsteads dotted across the study area and also from vehicles travelling along the R546 main road and local access roads that pass through the site. Overall, the visual character of the night environment within the study area is considered to be moderately 'polluted' and will therefore **not** be regarded as pristine.

However, power lines and associated towers or pylons are not usually lit up at night and, thus light spill associated with the proposed electrical infrastructure project is only likely to emanate from the proposed substation. Although the lighting required at the substation site would normally be expected to intrude on the nightscape, night time impacts of this lighting will be reduced by the fact the night environment is already moderately polluted. It should also be noted that the EGI project will only be constructed if the proposed Munodeleli WEF is also developed. Light sources for this facility will include operational and security lighting and thus the lighting impacts from the proposed substation would be subsumed by the glare and contrast of the lighting associated with the WEF. As such, the substation alone is not expected to result in significant lighting impacts.

6.3.4 SOCIO-ECONOMIC

SOCIAL OVERVIEW OF THE STUDY AREA

The study area is located approximately 8-10 south of the town of Secunda in the GMM. The town of Secunda has its origins in the 1973/74 international oil crisis when the then South African Government took the decision to establish a second coal liquefaction plant following the establishment of the first at Sasolburg in the 1950s. After the site for the Sasol complex had been identified, it had to be decided whether or not to combine the existing towns of Evander and Trichardt. The huge burden that extensions of this nature would have had on the financial and administrative resources of the established communities as well as the tempo at which such development should proceed was decisive and resulted in the decision to develop Trichardt and Secunda to be one town, named Secunda. Evander, located ~ 8km to the west of the current day Secunda, remained a separate town. Trichardt borders onto the northern part of Secunda.

The first town area was proclaimed in June 1976[8]. The name Secunda is derived from the from the Latin, secundi meaning second/following, and was given to the town as it was the second extraction refinery producing oil from coal, after Sasolburg, which is located approximately 140km west of Secunda. The town was located adjacent to the large coalfields in the area, including the Evander and Winkelhaak coal mines located to the north west of the town. The Secunda facility consists of Sasol Two (1980) and Sasol Three (1982) is the largest coal liquefaction plant in the world, and produces synthetic fuel, diesel, and related fuels and petrochemicals from coal gasification. The Secunda facility is located to the south of the town, approximately 3.5 km from the northern boundary of the WEF site **(Figure 6-20**). The town of Secunda is located approximately 90 km west of Benoni in Gauteng, and 23 km west of Bethal. The N17 which runs to the north of the town and the site connects the towns of Benoni and Bethal. The small settlement of Charl Cilliers is located ~ 2km to the south of the WEF site. The Brandspruit Mine is located ~ 1.5 km to the north of the northern boundary of the WEF site. The Mukondeleli WEF grid connection project is located partially within and partially to the south of SASOL's Secunda complex south of the town of Secunda. The small residential settlement of Charl Cilliers is located approximately 1.5 km to the south of the WEF project site.

[8] https://www.primidi.com/secunda_mpumalanga/early_history

Figure 6-20: Secunda Sasol Facility

ADMINISTRATIVE CONTEXT

The study area is located within the GMM within the Mpumalanga Province. The GMM is one of the seven Local Municipalities that make up the Gert Sibande District Municipality. The town of Secunda is the administrative seat of the GMM (**Figure 6-21**).

Figure 6-21: Location of Govan Mbeki Municipality within the Gert Sibande District Municipality.

DEMOGRAPHIC OVERVIEW

POPULATION

The population of the GMM in 2016 was 340 091 (Community Household Survey 2016). Of this total, 32.5% were under the age of 18, 63.3% were between 18 and 64, and the remaining 4.2% were 65 and older. The GMM therefore had a high percentage of the population that fall within the economically active group of 18-65. The population of Ward 5 in 2011 was 9 219 (Census 2011). Of this total, 21.5% were under the age of 18, 72.1% were between 18 and 64, and the remaining 6.4% were 65 and older. Ward 5 like the GMM also had a high percentage of the population that fall within the economically active group of 18-65. The figures are higher than the figures for the GSDM and Mpumalanga (57.7% and 56.6% respectively). This is due to the employment opportunities associated with the industrial, mining and manufacturing activities in the MM.

The dependency ratio is the ratio of non-economically active dependents (usually people younger than 15 or older than 64) to the working age population group (15-64). The higher the dependency ratio the larger the percentage of the population dependent on the economically active age group. This in turn translates to reduced revenue for local authorities to meet the growing demand for services. The traditional approach is based people younger than 15 or older than 64. The information provided provides information for the age group under 18. The total number of people falling within this age group will therefore be higher than the 0-15 age group. However, most people between the age of 15 and 17 are not economically active (i.e., they are likely to be at school).

Using information on people under the age of 18 is therefore likely to represent a more accurate reflection of the dependency ratio. Based on these figures, the dependency ratios for the GMM, the GSDM and Mpumalanga in 2016 were 58%, 73.5% and 77% respectively. The dependency ratio for Ward 5 in 2011 was 38.6%. The lower dependency ratios in the GMM and Ward 5 reflect the employment and economic opportunities in and around Secunda linked to the towns petrochemical and industrial sector.

In terms of race groups, Black Africans made up 85.8% of the population on the GMM, followed by Whites, 12.1% and Coloureds (1.2%). The figures for Ward 5 in 2011 were Whites (72.6%), Black Africans (22.2%), Indian or Asian (2.7%) and Coloureds (2.3%). The main first language spoken in the GMM was isizulu, 60.5%, followed by Siswati, 7.3% and Afrikaans, 6.2%. In Ward 5 Afrikaans (64.6%) followed by English (11.1%) were the main languages spoken.

HOUSEHOLDS AND HOUSE TYPES

The total number of households in the GMM in 2016 was 108 892, which constituted approximately 33% of the total number of households in the GSDM. Of these 63% were formal houses, 20.4% were shacks, and 10.6% were flats in backyards. The figures for the GSDM were 67.2%, 13.4%, 6.7% and 8.3% respectively. While the majority of dwellings in the GMM are formal structures there are a high percentage of informal structures which reflects the migration of jobseekers to the area and the pressure this in turn places on housing. In Ward 5 82.5% of the dwellings were formal houses. There were no reported shacks.

In terms of ownership, 46% of the dwellings in the GMM were owned and fully paid off, while 10.6% were in the process of being paid off. 17.9% of the dwellings were rented from private individuals. In Ward 5, 15.2% were owned and fully paid off, 34.2% were in the process of being paid off, and 35% were rented. A relatively large percentage of the properties in the GMM (56.6%) were owned and or in the process of being paid off. This reflects a relatively stable and established community.

In terms of household heads, approximately 30.8% of the households in the GMM and 39.1% of the households in the GSDM were headed by women. These figures similar to the provincial figure of 39.71%. The figure for Ward 5 in 2011 was substantially lower at 15.5%. The high percentage of households headed by women in the GMM reflects the likelihood that the men have left the area in search of employment opportunities in Gauteng. This is despite the well-developed industrial sector in and around Secunda. Women headed households tend to be more vulnerable.

HOUSEHOLD INCOME

Based on the data from the 2011 Census, 16.6% of the population of the GMM had no formal income, 3.6% earned less than R 4 800, 5.5% earned between R 5 000 and R 10 000 per annum, 12.6% between R 10 000 and R 20 000 per annum and 16.4% between R 20 000 and 40 000 per annum (2016). The poverty gap indicator produced by the World Bank Development Research Group measures poverty using information from household per capita income/consumption. This indicator illustrates the average shortfall of the total population from the poverty line. This measurement is used to reflect the intensity of poverty, which is based on living on less than R3 200 per month for an average sized household (~ 40 000 per annum). Based on this measure, in the region of 54.7% of the households in the GMM and 65.2% in the GSDM live close to or below the poverty line. The figure for Ward 5 in 2011 was 16.9%.

The low-income levels in the GMM and GSDM reflect the limited formal employment opportunities outside in the urban areas. This is also reflected in the high unemployment rates. The low-income levels are a major concern given that an increasing number of individuals and households are likely to be dependent on social grants. The low-income levels also result in reduced spending in the local economy and less tax and rates revenue for the GMM. This in turn impacts on the ability of the GMM to maintain and provide services.

Household income levels are likely to have been impacted by the COVID-19 pandemic. The number of households in the GMM and GSDM that live close to or below the poverty line is likely to have increased over the last 18 months. This, coupled with the high dependency ratio, is a major cause of concern for the area.

EMPLOYMENT

The official unemployment rate in the GMM in 2016 was 17.2%, while 48.5% were employed, and 31% were regarded as not economically active. The figures for Ward 5 in 2011 were 3.6%, 63.6% and 32.4% respectively. However, the COVID-19 pandemic is likely to have resulted in an increase in unemployment rates in both the GMM and Ward 5. Recent figures released by Stats South Africa also indicate that South Africa’s unemployment rate is in the region of 36%, the highest formal unemployment rate in the world.

EDUCATION

In terms of education levels, the percentage of the population over 20 years of age in the GMM and GSDM with no schooling was 6.5% in 2016, compared to 10.8% and 11.3% for the GSDM and Mpumalanga Province respectively. The figure for Ward 5 in 201 was 1.8%. The percentage of the population over the age of 20 with matric in the GMM (2016) and Ward 5 (2011) was 39.4% and 39.2% respectively, compared to 34.3% and 36.1% for the GSDM and Mpumalanga. The education levels in the GMM and Ward 5 are therefore marginally higher than the DM and Provincial figures.

MUNICIPAL SERVICES

ELECTRICITY

Based on 2016 survey, 95.1% of households in the GMM had access to electricity, compared to 90% for the GSDM and 93% for Mpumalanga.

ACCESS TO WATER

Based on the 2016 survey information, 96.9% of households in the GMM were supplied by a service provider. This compares to 86.7% and 80.5% for the GSDM and Mpumalanga respectively. The figure for Ward 5 in 2011 was 91.4%.

SANITATION

94.9% of the households in the GMM had access to flush toilets (2016), while 3.4% relied on pit toilets. This compares to 65.3% and 42.1% for the GSDM and Mpumalanga respectively. The figure for Ward 5 in 2011 was 94.5%. Only 0.5% of the households in the GMM reported that they had no access to formal sanitation, compared to 2.6% and 2.8% for the GSDM and Mpumalanga respectively.

REFUSE COLLECTION

72.5% of the households in the GMM had access to regular refuse removal service, while for 13.9% the service was provided, but not on a regular basis. This compares to 52.2% for the GSDM (regular) and 5.2% (irregular). 89% of households in Ward 5 had their waste collected on a regular basis by a service provided.

6.4 HEALTH AND SAFETY

A high-level Safety Health and Environmental Risk Assessment was conducted by ISHECON for the proposed Solid-State Lithium (SSL) or Vanadium Redox Flow (VRF) BESS systems.

6.4.1 VANADIUM REDOX FLOW BATTERY HAZARDS

HAZARD – TOXICITY AND CORROSIVITY

The electrolyte in the VRF system is corrosive. It is composed of a sulphuric acid-based solution similar to common automotive lead acid batteries. Unlike traditional lead-acid batteries, VRBs do not include lead.

Therefore, VRBs do not have the toxicity issues of lead that conventional car batteries have. The only potential source of human toxicity in a VRB is Vanadium.

Vanadium in various physio-chemical states can have a relatively high aquatic and human toxicity. Acute oral exposure to high doses can lead to hemorrhaging, while chronic exposure leads to adverse effects on the digestive system, kidneys and blood (diarrhea, cramps etc.).

Inhalation hazards lead to irritation of the respiratory tract, bronchospasm, pulmonary congestion. There is little evidence that vanadium compounds are reproductive toxics or teratogens. There is also no evidence that it is carcinogenic (Source USA EPA Risk Assessment Information Systems, Toxicity Profiles, Vanadium 1998).

In the electrolyte the concentration levels of Vanadium are so low that when it is mixed into liquid form in the final product and put into operation, the VRB is deemed non-toxic. In addition, VRBs have a lower concentration of sulfuric acid than traditional lead-acid batteries. Vanadium poses a hazard when it is in powder form, i.e. when making up the electrolyte solution. The Mukondeleli facilities will purchase electrolyte already made up and there will be no solid vanadium powder on site.

Toxicity or corrosion risks may be present from off-gassing produced by over-heating aqueous or vaporized electrolytes. In addition, flow batteries in fire scenarios may generate toxic gas from the combustion of hydrocarbons, plastics, or acidic electrolytes. Refer to sections on fire below for mitigation measures.

HAZARD – ELECTRICAL SHOCK/ARC

Electrical shock presents a risk to workers and emergency responders, if the energy storage system cannot be “turned off”. This is referred to as “stranded energy” and presents unique hazards. Arc flash or blast is possible for systems operating above 100 V. Li-ion systems operate from 48 - 1000 V, depending on the battery design.

In the area of shock hazard, a flow battery produces voltage only when electrolytes are in a cell stack. For most designs, if the motors are turned off and fluids drained from the cell stack, then the cell stacks have no measurable voltage at the terminals. This happens not only when the battery is forcible turned off but also in the standby mode as vanadium batteries do not include any metal plates to hold the chemical reactions / charges / voltages and can be fully drained when not in use.

If not fully drained, vanadium flow batteries are also unique in terms of short circuiting in that the internal dynamics of the battery are such that the energy discharge is limited to the fluid in the battery at any given time and the is typically less than 1% of the total stored energy. Therefore, together with the relatively low energy density of the vanadium electrolyte, the immediate release of energy, which occurs as a result of electrical shorting, is somewhat limited. The high heat capacity of the aqueous electrolyte is also beneficial in limiting the temperature rise.

Vanadium flow batteries have been tested under dead-short conditions resulting in normal operation with no danger to either equipment or personnel.

HAZARD – FIRE / DEFLAGRATION

Over 50% of the electrolyte solution is made up of water, which gives the electrolyte a non-flammable property. In the event of short circuiting, intense heat or high pressure, it is unlikely for the battery to catch fire. There is no “thermal runaway” risk when compared to other battery technologies.

Whilst some heat may be discharged from the battery, it will not be at a level that is deemed unsafe. Like all other RFBs, VRFs also have a battery management system. A battery management system ensures optimum and safe conditions for battery operation. Often a heat management system is integrated to avoid too high or too low temperatures.

HAZARD - HYDROGEN GENERATION

As with all other aqueous batteries, aqueous energy storage media from redox flow batteries are also subject to water limitations. In case of too high voltages or more precisely too high or too low half-cell potentials, the water is decomposed into its components, hydrogen and oxygen. The generation of hydrogen in particular is often present as a very small but undesirable side reaction and causes a charge carrier imbalance between positive and negative half-cells, which leads to a slow loss of capacity. It also presents a fire / explosion hazard.

With VRF, due to the flowability of the energy storage medium, the reaction products that would normally remain in the half-cell can be transported out of the cell and stored in separate tanks thus allowing the capability for a higher capacity than that attainable with conventional batteries. In addition, any deviations from safe operating parameter will trigger the shutdown of the system pumps ceasing to charge the electrolyte and thereby reducing the changes of accidental H2 generation. In addition, the thermal mass of the electrolyte tanks can provide an additional barrier to overcharging conditions by allowing ambient temperature during the discharge times to cool the VRF for the next charge cycle.

HAZARD – WASTE ELECTROLYTE

Unfortunately, pentavalent vanadium ions have a tendency to react with each other, which leads to the formation of larger molecules which precipitate as solids and can thus damage the system. The reaction depends on the temperature and the concentration of VO2+ (state of charge) but is also a function of the proton concentration. Temperature and concentrations therefore need to be controlled within specified ranges.

Should the concentration of undesirable components increase in the electrolyte, a part may need to be purged and replaced with fresh electrolyte.

HAZARD - ELECTROLYTE LEAKS

Leaks must be expected in any hazardous-fluid handling equipment. Secondary containment is typically designed into the system and standard corrosive PPE is required for handling liquid. Reliable leak detection, annunciation, and containment is paramount.

As with any chemicals plant a suitable design with detection, alarm and trip instrumentation that has been subject to thorough Hazop study should be in place, e.g. detection of dry running of pumps, detection of dead heading of pumps, prevention of reverse flow, detection of drop in tank levels etc.

6.4.2 SOLID STATE LITHIUM BATTERY CHEMICAL HAZARDS

HAZARD - THERMAL DECOMPOSITION

Upon heating of the contents of a battery due to shorting, contaminants, external heat or exposure to water and reaction heat, the lithium salts in batteries begin to break down exothermically to release either oxygen (oxidants) that enhances combustion, possibly leading to explosion, or fumes such as hydrogen fluoride or chlorine that are toxic.

These exothermic break down reactions are self-sustaining above a certain temperature (typically 70 deg C) and can lead to thermal run away. In this process the battery gets hotter and hotter, the decomposition reactions happen faster and faster and excessive hot fumes are generated in the battery. Eventually the pressure in the battery builds up to the point where those gases need to vented, usually via the weakest point in the system. These vented fumes can be flammable due to vaporization of the electrolyte and can ignite as a flash fire or fire ball (if large amounts) leading to the fire spreading to any surrounding combustible materials, e.g. plastic insulation on cables, the electrolyte, the electrodes and possibly even the plastic parts of the battery casing etc. If the vented flammable vapours do not ignite immediately, they can accumulate within the surrounding structures. If this flammable mixture is ignited later, e.g. due to a spark, this can lead to a violent explosion of the module, cabinet, room, container etc. In addition to being flammable the vented gases will contain toxic components. These could include:

- The products of combustion such as carbon dioxide/monoxide, hydrogen cyanide
- VOCs like benzene and ethylene,

— Decomposition products such as hydrogen fluoride, hydrogen chloride, phosphorous pentafluoride, phosphoryl fluoride and oxides of aluminium, cobalt, copper etc.

The temperature in the batteries and of these vented gases can be extremely high, e.g. > 600 deg C.

In the situation where oxygen is released internally as part of the decomposition (e.g. lithium perchlorate) the oxygen is available to react with the combustible electrolyte and if all this happens extremely fast in a self-sustaining manner within the confines of the device, an explosion of the device can result.

HAZARD - PROPAGATION

A BESS is composed of individual batteries which are combined into different size packs such as modules, racks. The very high temperature generated by one battery cell in thermal run away could lead to overheating of adjacent cells. This cell in turn then starts thermal decomposition and so the process propagates through the entire system. In order to prevent propagation, there are separation requirements between cells, modules etc. Separation could be with physical space or insulating materials etc.

HAZARD - ELECTROLYTE LEAKS

Although extremely unlikely due to the structure of the batteries, should electrolyte liquid leak out of the batteries, it can be potentially flammable as well as corrosive etc. If ignited as fire, or explosion, the smoke would contain toxic components. If unignited it can still be extremely harmful especially if its decomposition products include hydrofluoric acid.

6.4.3 OTHER CHEMICALS OR HAZARDS

The BESS is composed not only of the batteries. There are electrical connections, switches, power converters, cooling systems etc.

COOLING SYSTEMS

Due to the need to keep the batteries within a specified temperature range most of the containerized modular system have built-in air-conditioning systems while the VRF building systems may have cooling water systems. Some have only fans for air cooling with filters to remove dust prior to cooling. Others, particularly those in hot environments requiring more cooling, may have refrigerant-based systems. These would have a refrigerant circuit usually containing non-flammable non-toxic refrigerant such as R134a (simple asphyxiant) etc as well as a low hazard circulating medium such as an ethylene glycol-based coolant. At high temperatures above 250 deg C R134 may decompose and may generate hydrogen fluoride and other toxic gases. Ethylene glycol is really only harmful if swallowed. In the environment it breaks down quickly and at low concentrations that would typically occur from occasional small spills, it has no toxicity.

FIRE SUPPRESSION SYSTEMS

Although these are only effective for some fire scenarios, some of the solid-state containerized systems come fitted with “Clean agent” fire suppressant systems. These are pressurized containers of powder/gases that are released into the container to snuff a fire and do not leave a residue on the equipment.

Some containers have water sprinkler systems installed to quench thermal run-away reactions.

VRF batteries do not present a high fire risk. However, on any chemical plant there is always the risk of fires with electrical equipment and other materials used on site. Fire systems would typically consist of local strategically placed extinguishers as well as a fire water hose/hydrant system.

In general fire fighters may respond with water cannons/hydrants, foam systems etc. Such responses may generate large amount of contaminated and hazardous water runoff. A system to contain as much of this as possible should be in place.

GENERAL ELECTRICAL AND ELECTRONIC EQUIPMENT

Whatever the configuration of the battery containers/ buildings there will be electrical and electronic equipment in the battery compartment, the battery building as well as outside. In some installations the main electrical equipment such as the power conversion system is in a separate compartment separated by a fire wall. In others it can be in a separate container.

Wherever there is electrical equipment there is a possibility of shorting and overheating and fire.

7 ENVIRONMENTAL IMPACT ASSESSMENT

This Chapter identifies the perceived environmental and social effects associated with the proposed Project. The assessment methodology is outlined in **Section 3.5**. The issues identified stem from those aspects presented in **Chapter 6** of this document as well as the Project description provided in **Chapter 4**. The impact assessment is based on the preferred alternative at all Project phases. This section only assesses the preferred option along with the no-go alternative. The impact mitigation hierarchy criteria, as per **Section 3.5.2**, for each mitigation measure are indicated in brackets after each measure indicated.

Furthermore, a decommissioning assessment will be considered as part of the decommissioning process that will be subject to a separate authorisation and impact assessment process. Any decommissioning impacts will be assessed at this stage. The impact assessment in this section encompasses the geographical, physical, biological, social, economic, heritage and cultural aspects in accordance with Appendix 1 of GNR 326.

7.1 AIR QUALITY

7.1.1 CONSTRUCTION PHASE

DUST AND PARTICULATE MATTER

The National Dust Control Regulations (GNR 827) prescribe general measures for the control of dust in both residential and non-residential areas and will be applicable during construction of the OHPL. **Table 7-1** provides the acceptable dust fall rates as prescribed by GNR 827.

Table 7-1: Acceptable dust fall rates (GNR 827)

RESTRICTION AREAS	DUST FALL RATE (D) (mg/m^2/day – 30 DAYS AVERAGE)	PERMITTED FREQUENCY OF EXCEEDING DUST FALL RATE
Residential area	D < 600	Two within a year, not sequential months
Non-residential area	600 < D < 1200	Two within a year, not sequential months

During the construction phase, dust and vehicular emissions (carbon monoxide (CO), hydrocarbons, particulate matter (PM) and nitrogen oxides (NO_x) will be released as a result of vegetation clearing activities, transportation of equipment and materials to site, and the installation thereof, all of which involves the movement of large plant and trucks along unpaved roads and exposing of soils. The emissions will, however, have short-term impacts on the immediate surrounding areas that can be easily mitigated and thus the authorisation of such emissions will not be required. All construction phase air quality impacts will be minimised with the implementation of dust control measures contained within the EMPr (**Appendix G).**

The impact of the construction phase on the generation of dust and particulate matter (PM) is shown in **Table 7-2**.

Table 7-2: Construction Impact on Generation of Dust and PM

Potential Impact GENERATION OF DUST AND PM	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Without Mitigation	2	2	3	1	4	**32**	**Moderate**	(-)	High
With Mitigation	1	1	3	1	3	**18**	**Low**	(-)	High

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Confidence
GENERATION OF DUST AND PM								
Mitigation and Management Measures	— Dust-reducing mitigation measures must be put in place and must be strictly adhered to, for all roads and soil/material stockpiles especially. This includes wetting of exposed soft soil surfaces and not conducting activities during high wind periods which will increase the likelihood of dust being generated; — All stockpiles (if any) must be restricted to designated areas and may not exceed a height of two (2) metres; — Ensure that all vehicles, machines and equipment are adequately maintained to minimise emissions; — It is recommended that the clearing of vegetation from the site should be selective, be kept to the minimum feasible area, and be undertaken just before construction so as to minimise erosion and dust potential; — All materials transported to, or from, site must be transported in such a manner that they do not fly or fall off the vehicle. This may necessitate covering or wetting friable materials. — Enforcing of speed limits. Reducing the dust generated by the listed activities above, putting up signs to enforce speed limit in access roads. — No burning of waste, such as plastic bags, cement bags and litter is permitted; and — All issues/complaints must be recorded in the complaints register.							

7.1.2 OPERATIONAL PHASE

There are no anticipated air quality impacts during the operational phase as maintenance activities will occur as and when required and will be extremely short term.

7.1.3 DECOMMISSIONING PHASE

The impacts associated with the decommissioning phase are expected to be the same as the construction phase.

7.2 NOISE EMISSIONS

7.2.1 CONSTRUCTION PHASE

Elevated noise levels are likely to be generated by the construction activities (machinery and vehicles) and the workforce. It is important to note that noise impacts (nuisance factor) may vary in the different areas as a result of the surrounding land uses and will be temporary in nature. Due to the temporary and limited nature of the Project activities, coupled with the fact that there are a limited number of noise receptors around the Project area, the impact is regarded as low. The construction impact on noise is indicated in **Table 7-3** below.

Table 7-3: Construction Impact on Noise

Potential Impact: NOISE	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Without Mitigation	2	1	3	1	4	**28**	**Low**	(-)	High
With Mitigation	2	1	1	1	3	**15**	**Low**	(-)	High
Mitigation and Management Measures	— The equipment must be in maintained in good working order, within service dates, and inspected before use; — Align working times with the substation related operational times; and — Install noise reducing fittings on machinery (if required).								

7.2.2 OPERATIONAL PHASE

There are no anticipated noise impacts during the operational phase as maintenance activities will occur as and when required and will be extremely short-term.

7.2.3 DECOMMISSIONING PHASE

The impacts associated with the decommissioning phase are expected to be the same as the construction phase.

7.3 SOILS, LAND CAPABILITY AND AGRICULTURAL POTENTIAL

An agricultural impact is a temporary or permanent change to the future production potential of land. The significance of the agricultural impact is directly proportional to the extent of the change in production potential. If a development will not change the future production potential of the land, then there is no agricultural impact.

The proposed overhead powerline has negligible agricultural impact, regardless of its route and design and the agricultural potential of the land it traverse. All agricultural activities can continue completely unhindered underneath the powerline. This is because its direct, permanent, physical footprint that has any potential to interfere with agriculture (pylon bases and servitude track, where it is needed), is insignificantly small and the pylons can mostly be located outside of or on the edges of cropland where they minimise interference with crop production. There will therefore be negligible reduction in future agricultural production potential underneath the powerline. The only potential source of impact of the powerline is minimal disturbance to the land (erosion and topsoil loss) during construction (and decommissioning). This impact can be completely mitigated with standard, generic mitigation measures that are included in the generic DFFE EMPr.

The only impact of this development is therefore the loss of approximately 2 hectares of agricultural land on the site of the substation. The significance of the loss of agricultural land is a direct function of two things, firstly the amount of land that will be lost and secondly, the production potential of the land that will be lost. In this case the amount of land loss is very small and the land is of insufficient land capability for crop production. The significance of the agricultural impact is therefore assessed as very low.

The impact on Agricultural Production Potential lost is outlined in **Table 7-4**.

Table 7-4: Impact on Agricultural Production Potential loss

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Agricultural potential loss									
Without Mitigation	2	1	3	4	1	**10**	**Very Low**	(-)	High
With Mitigation	2	1	3	4	1	**10**	**Very Low**	(-)	High
Mitigation and Management Measures	— Maintain vegetation and facilitate re-vegetation. — Strip, stockpile and re-spread topsoil.								

7.4 SOIL EROSION AND CONTAMINATION

7.4.1 CONSTRUCTION PHASE

SOIL EROSION

During the construction phase, measures should be implemented to manage stormwater and water flow on the site. If the stormwater and water flow is not regulated and managed on site, it could cause significant erosion of soil around the cleared areas.

During the construction phase, the Project activities could leave soils exposed and susceptible to erosion. The construction impact on soil erosion is indicated in **Table 7-5** below.

Table 7-5: Construction Impact on Soil Erosion

Potential Impact:	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
SOIL EROSION									
Without Mitigation	2	1	3	2	4	**32**	**Moderate**	(-)	High
With Mitigation	1	1	3	2	3	**21**	**Low**	(-)	High
Mitigation and Management Measures	— Only the proposed monopole foundation footprint areas should be cleared of vegetation. This should be done in stages as construction works progress, if possible; — Implement stormwater management measures that will help to reduce the speed of the water. These measures must also assist with the prevention of water pollution, erosion and siltation; — Any exposed earth should be rehabilitated promptly, and this could include planting suitable vegetation (vigorous indigenous grasses) that mimics the surrounding environment to protect the exposed soil; — If excavations or foundations fill up with stormwater, these areas should immediately be drained and measures to prevent access to these areas should be implemented; — Erosion control measures should be implemented during the construction phase on large, exposed areas and where stormwater is temporarily channelled; — Stormwater channels and preferential flow paths should be delineated, filled with aggregate and/or logs (branches included) to dissipate and slow flows, limiting erosion; and — Rehabilitate the area to manage erosion as soon as practicably possible.								

SOIL CONTAMINATION

During construction activities, construction vehicles/trucks/machinery as well as hazardous substances stored on the site might spill and contaminate the soil. The impact of the construction phase on soil pollution is indicated in **Table 7-6** below.

Table 7-6: Construction Impact on Soil Contamination

Potential Impact: SOIL CONTAMINATION	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Without Mitigation	2	1	3	3	4	**36**	**Moderate**	(-)	High
With Mitigation	1	1	3	2	3	**21**	**Low**	(-)	High
Mitigation and Management Measures	— All construction vehicles, plant, machinery and equipment must be properly maintained to prevent leaks; — Plant and vehicles are to be repaired immediately upon developing leaks; — Drip trays shall be supplied for all idle vehicles and machinery; — No repair work may be undertaken on machinery onsite or within the site camp area; — Drip trays are to be utilised during daily greasing and re-fuelling of machinery and to catch incidental spills and pollutants; — Drip trays are to be inspected daily for leaks and effectiveness and emptied when necessary. This is to be closely monitored during rain events to prevent overflow; — Ensure appropriate handling of hazardous substances; — Keep adequate spill kits onsite and train personnel to use them appropriately; — Fuels and chemicals must be stored in adequate storage facilities that are secure, enclosed and bunded; and — Implement stormwater management measures that will help to reduce the speed of the water flows.									

7.4.2 OPERATIONAL PHASE

SOIL EROSION

There are no anticipated soil erosion impacts expected during the operational phase as maintenance activities will occur as and when required and will be extremely short-term. However, erosion and stormwater controls should be set up around the monopoles during construction to protect them during the operational phase.

SOIL CONTAMINATION

Soil contamination is expected to be limited during the operational phase as maintenance activities will occur as and when required and will be extremely short-term. The operational impact on soil contamination is indicated in **Table 7-7** below.

Table 7-7: Operation Impact on Soil Contamination

Potential Impact: SOIL CONTAMINATION	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Without Mitigation	2	1	3	3	3	**27**	**Low**	(-)	High

Potential Impact: SOIL CONTAMINATION	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
With Mitigation	1	1	3	2	2	**14**	**Low**	(-)	High
Mitigation and Management Measures	— All vehicles, plant, machinery and equipment must be properly maintained to prevent leaks; — Vehicles and machinery are to be repaired immediately upon developing leaks; — Drip trays shall be supplied for all idle vehicles and machinery; — No repair work may be undertaken on machinery on site; — Drip trays are to be utilised during daily greasing and re-fuelling of machinery and to catch incidental spills and pollutants; — Drip trays are to be inspected daily for leaks and effectiveness and emptied when necessary. This is to be closely monitored during rain events to prevent overflow; — Ensure appropriate handling of hazardous substances; — Keep a spill kit on site and train personnel to use it appropriately; and — Fuels and chemicals must be stored in adequate storage facilities that are secure, enclosed and bunded.								

7.4.3 DECOMMISSIONING PHASE

The impacts associated with the decommissioning phase are expected to be the same as the construction phase.

7.5 GROUNDWATER

7.5.1 CONSTRUCTION PHASE

DETERIORATION IN GROUNDWATER QUALITY

There is a potential to affect the groundwater quality in the area. This is influenced by spills and leaks and the storage of chemicals and fuels. Any contaminants that are not cleaned from the ground will seep into underground water resources. The impact of construction on change in water quality is shown in **Table 7-8** below.

Table 7-8: Construction Impact on Deterioration in Groundwater Quality

Potential Impact: DETERIORATION IN GROUNDWATER QUALITY	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Without Mitigation	3	2	3	2	3	**30**	**Moderate**	(-)	High
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	High
Mitigation and Management Measures	— Construction areas should be demarcated, and wetland areas marked as “restricted” in order to prevent the unnecessary impact to and loss of these systems; — Laydown yards, camps and storage areas must be beyond the wetland areas where applicable;								

Potential Impact: DETERIORATION IN GROUNDWATER QUALITY	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Confidence
	— During construction, contractors used for the Project must have spill kits available to ensure that any fuel or oil spills are cleaned-up and disposed of correctly; — A suitable stormwater management plan must be generated for the project to control the movement of water on the substation site; — The stormwater management plan should incorporate "soft" engineering measures as much as possible, limiting the use of artificial materials; — As much material must be pre-fabricated and then transported to site to avoid the risks of contamination associated with mixing, pouring and the storage of chemicals and compounds on site; — All chemicals and toxicants during the construction and operation phase must be stored in bunded areas; — All machinery and equipment should be inspected regularly for faults and possible leaks; these should be serviced off-site; — All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping"; — Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the Project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation); and — Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the aquatic systems.							

7.5.2 OPERATIONAL PHASE

There are no anticipated groundwater quality impacts expected during the operational phase as maintenance activities will occur as and when required and will be extremely short-term.

7.5.3 DECOMMISSIONING PHASE

The impacts associated with the decommissioning phase are expected to be the same as the construction phase.

7.6 AQUATIC

7.6.1 CONSTRUCTION PHASE

CHANGES IN WATER FLOW REGIME

Changes in flow regime arises from the compaction of soil, the removal of vegetation and surface water redirection. Changes to hydrological function at a landscape level which can arise from changes to flood regimes (i.e. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes). The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary, seasonal, permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.). Changes to base flows i.e. too little/too much water in terms of characteristics and requirements of system). Fragmentation (i.e. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal). The construction impact along with mitigation measures are outlined in **Table 7-9.**

Table 7-9: Construction Impact on water flow regime

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in water flow regime									
Without Mitigation	3	3	3	4	4	52	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	4	2	22	**Low**	(-)	
Mitigation and Management Measures	— Pylons should be placed outside delineated watercourses and their associated buffer zones. — Prevent access of heavy vehicles and machinery in the wetlands or riparian areas — Rehabilitation plans must be submitted and approved for rehabilitation of damage during the construction phase and that plan must be implemented immediately upon completion of construction. — Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access. — Implementation of best management practices								

CHANGES IN SEDIMENT ENTERING AND EXITING THE SYSTEM

Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount). Construction and operational activities will result in earthworks and soil disturbance as well as the removal of natural vegetation. This could result in the loss of topsoil, sedimentation of the watercourse and increase the turbidity of the water. Possible sources of the impacts include:

- Earthwork activities during construction
- Clearing of surface vegetation will expose the soils, which in rainy events would wash through the watercourse, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive trees can spread easily into these eroded soil.
- Disturbance of soil surface
- Disturbance of slopes through creation of roads and tracks adjacent to the watercourse
- Erosion (e.g. gully formation, bank collapse)

Changes in sediment regimes of the aquatic ecosystem and its sub -catchment by for example sand movement, meandering river mouth /estuary, changing flooding or sedimentation patterns. The construction impact along with mitigation measures are outlined in **Table 7-10**.

Table 7-10: Construction Impact on sediment entering and exiting the system

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	33	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	2	20	**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Mitigation and Management Measures	— Where development is located upslope from wetlands, a temporary fence or demarcation must be erected around No-Go Areas outside the proposed works area prior to any construction taking place as part of the contractor planning phase when compiling work method statements to prevent access to the adjacent portions of the watercourse. — Where development is located upslope from wetlands, effective stormwater management including sediment barriers should be a priority during both construction and operational phase. This should be monitored as part of the EMP. — Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction/earthworks in that area. — Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas. — Monitoring should be done to ensure that sediment pollution is timeously dressed. — Prevent access of heavy vehicles and machinery in the delineated watercourses — Rehabilitation plans must be submitted and approved for rehabilitation of damage during construction phase and that plan must be implemented immediately upon completion of construction. — Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access. — Implementation of best management practices									

INTRODUCTION AND SPREAD OF ALIEN VEGETATION

The moving of soil and vegetation resulting in opportunistic invasions after disturbance. Invasions of alien plants can impact on hydrology, by reducing the quantity of water entering a watercourse, and outcompete natural vegetation, decreasing the natural biodiversity. Once in a system, alien invasive plants can spread through the catchment. If allowed to seed before control measures are implemented alien plants can easily colonise and impact on downstream users. The construction impact along with mitigation measures are outlined in **Table 7-11**.

Table 7-11: Construction Impact on the Introduction and spread of alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	3	3	3	3	36	Moderate	(-)	Moderate
With Mitigation	2	2	3	3	2	20	Low	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Mitigation and Management Measures	— The powerline and substation currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields — Monitor the establishment of alien invasive species within the areas affected by the construction and maintenance and take immediate corrective action where invasive species are observed to establish. — Undertake an Alien Plant Control Plan which specifies actions and measurable targets — Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction/earthworks in that area and returning it where possible afterwards. — Long-term monitoring for the establishment of alien invasive species within the areas affected by the construction and maintenance and take immediate corrective action where invasive species are observed to establish, as specified in the Alien Vegetation Management Plan. — Rehabilitate or revegetate disturbed areas.								

LOSS AND DISTURBANCE OF WATERCOURSE HABITAT AND FRINGE VEGETATION

Loss and disturbance of watercourse habitat and fringe vegetation due to direct development on the watercourse as well as changes in management, fire regime and habitat fragmentation. The construction impact along with mitigation measures are outlined in **Table 7-12**.

Table 7-12: Construction Impact on the loss and disturbance of watercourse habitat and fringe vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	4	3	36	Moderate	(-)	Moderate
With Mitigation	2	2	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— The Powerline and substation currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields — Monitor the establishment of alien invasive species within the areas affected by the construction and take immediate corrective action where invasive species are observed to establish. — Monitor rehabilitation and the occurrence of erosion twice during the rainy season for at least two years and take immediate corrective action where needed. — Operational activities should not take place within watercourses or buffer zones, nor should edge effects impact on these areas. — Operational activities should not impact on rehabilitated or naturally vegetated areas..								

CHANGES IN WATER QUALITY DUE TO POLLUTION

Changes in water quality due to input of foreign materials i.e. due to increased sediment load, contamination by chemical and /or organic effluent, and /or eutrophication. During the construction phase a large amount of waste will be produced including sewerage, domestic waste, wash-water, used oils and grease, diesel or lubricant spills, etc. Waste generally contains pollutants and present a potential risk to the water and surrounding environment if not managed effectively. Oil and diesel spillages may occur during the construction phase which can contaminate surface water. Other potential contaminants (i.e. from chemical toilets, domestic waste, storage facilities, workshop facilities, etc.) can reduce surface water quality or result in discharge that exceeds the maximum concentrations permitted by the National Water Act. Changes to the water quality could result in changes to the ecosystem structure and function as well as a potential loss of biodiversity. Water quality deterioration often leads to modification of the species composition where sensitive species are lost and organisms tolerant to environmental changes dominate the community structure. The construction impact along with mitigation measures are outlined in **Table 7-13**.

Table 7-13: Construction Impact on water quality

Potential Impact **Changes in sediment entering and exiting the system**	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Without Mitigation	3	2	3	3	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Provision of adequate sanitation facilities located outside of the watercourse or its associated buffer zone. — Implementation of appropriate stormwater management around the excavation to prevent the ingress of run-off into the excavation and to prevent contaminated runoff into the watercourse. — The development footprint must be fenced off from the watercourses and no related impacts may be allowed into the watercourse i.e. water runoff from cleaning of equipment, vehicle access etc. — Maintenance of construction vehicles/equipment should not take place within the watercourse or watercourse buffer. — Ensure that no operational activities impact on the watercourse or buffer area. This includes edge effects. — Control of waste discharges and do not allow dirty water from operational activities to enter the watercourse. — Regular independent water quality monitoring should form part of operational procedures in order to identify pollution. — Treatment of pollution identified should be prioritized according to best practice guidelines. — Develop norms and standards for the treatment of spills such as oil or hydraulic fluid. Ensure that the required equipment is available on hand to contain any spills. — Appoint a reliable contractor for the removal of refuse during the construction phase.								

LOSS OF AQUATIC BIOTA

Aquatic biota can be lost due to the disturbance of the habitat and direct impacts on the watercourse/ rivers/ streams. This can be attributed to Loss and disturbance of biota due to direct development on the watercourse as well as changes in habitat including water quality, the water column, increased sediment, increased alien vegetation fire regime and habitat fragmentation. The construction impact along with mitigation measures are outlined in **Table 7-14**.

Table 7-14: Construction Impact on aquatic biota

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	3	3	3	3	**36**	**Moderate**	(-)	Moderate
With Mitigation	2	3	3	3	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— This impact is not easily mitigated. Further loss in diversity can be minimised by following the mitigation measures mentioned above — The powerline infrastructure currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields or outside the watercourse and watercourse buffer								

7.6.2 OPERATIONAL PHASE

CHANGES IN WATER FLOW REGIME

The operation impact along with mitigation measures are outlined in **Table 7-15.**

Table 7-15: Operation Impact on water flow regime

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in water flow regime									
Without Mitigation	3	3	3	4	4	**52**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— The pylon and substation Structure currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields — Where development activities are located upslope from wetlands, effective stormwater management should be a priority during both construction and operational phase. This should be monitored as part of the EMP. — Effective culverts should be incorporated into the design of access roads..								

CHANGES IN SEDIMENT ENTERING AND EXITING THE SYSTEM

The operation impact along with mitigation measures are outlined in **Table 7-16**.

Table 7-16: Operation Impact on sediment entering and exiting the system

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	2	**20**	**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Mitigation and Management Measures	— The powerline and substation currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields — Where development is located upslope from wetlands, effective stormwater management including sediment barriers should be a priority during both construction and operational phase. This should be monitored as part of the EMP. — Monitoring should be done to ensure that sediment pollution is timeously dressed								

INTRODUCTION AND SPREAD OF ALIEN VEGETATION

The operation impact along with mitigation measures are outlined in **Table 7-17**.

Table 7-17: Operation Impact on the Introduction and spread of alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Monitor the establishment of alien invasive species within the areas affected by the construction and maintenance and take immediate corrective action where invasive species are observed to establish. — Undertake an Alien Plant Control Plan which specifies actions and measurable targets — Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction/earthworks in that area and returning it where possible afterwards. — Long-term monitoring for the establishment of alien invasive species within the areas affected by the construction and maintenance and take immediate corrective action where invasive species are observed to establish, as specified in the Alien Vegetation Management Plan.								

LOSS AND DISTURBANCE OF WATERCOURSE HABITAT AND FRINGE VEGETATION

The operation impact along with mitigation measures are outlined in **Table 7-18**.

Table 7-18: Operation Impact on the loss and disturbance of watercourse habitat and fringe vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	5	4	4	**56**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	3	**30**	**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Mitigation and Management Measures	— Amend powerline designs to exclude wetlands as well as buffer areas. — Monitor the establishment of alien invasive species within the areas affected by the construction and take immediate corrective action where invasive species are observed to establish. — Monitor rehabilitation and the occurrence of erosion twice during the rainy season for at least two years and take immediate corrective action where needed. — Operational activities should not take place within watercourses or buffer zones, nor should edge effects impact on these areas. — Operational activities should not impact on rehabilitated or naturally vegetated areas								

CHANGES IN WATER QUALITY DUE TO POLLUTION

The operation impact along with mitigation measures are outlined in **Table 7-19**.

Table 7-19: Operation Impact on water quality

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Amend powerline designs to exclude wetlands as well as buffer areas. — Provision of adequate sanitation facilities located outside of the watercourse or its associated buffer zone. — Maintenance of construction vehicles/equipment should not take place within the watercourse or watercourse buffer. — Ensure that no operational activities impact on the watercourse or buffer area. This includes edge effects. — Control of waste discharges and do not allow dirty water from operational activities to enter the watercourse. — Regular independent water quality monitoring should form part of operational procedures in order to identify pollution. — Treatment of pollution identified should be prioritized according to best practice guidelines. — Develop norms and practices for the treatment of spills such as oil or hydraulic fluid. Ensure that the required equipment is available on hand to contain any spills. — Appoint a reliable contractor for the removal of refuse during the operational phase..								

LOSS OF AQUATIC BIOTA

The operation impact along with mitigation measures are outlined in **Table 7-20**.

Table 7-20: Operation Impact on aquatic biota

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	5	3	39	Moderate	(-)	Moderate
With Mitigation	2	2	3	4	2	22	Low	(-)	
Mitigation and Management Measures	— This impact is not easily mitigated. Further loss in diversity can be minimised by following the mitigation measures mentioned above								

7.6.3 DECOMMISSIONING PHASE

The impacts associated with the decommissioning phase are expected to be the same as the construction phase.

7.7 BIODIVERSITY

7.7.1 CONSTRUCTION PHASE

The main biodiversity impacts associated with construction of the proposed Mukondeleli WEF up to 132kV grid connection transmission line include:

THE CLEARING OF NATURAL VEGETATION

Natural vegetation will be cleared for the pylons, new access roads and substations. The removal of indigenous vegetation may cause a loss of individuals of threatened, protected and/or endemic species and will also be accompanied by a loss of faunal habitat. However, no threatened or endemic plant species were found on site and all provincially protected plant species have a Least Concern status. None of the SCC listed by the Screening Tool, were recorded on site..

Since the pylon footprint is relatively small, the loss of prime habitat within the Soweto Highveld Grassland vegetation type will be minimal. Service roads generally have a larger impact on vegetation clearance, however since the roads will have a gravel surface animal movement should still be possible. Beyond the permanent infrastructure footprint, environmental functions and processes should however, not be altered. This impact as well as the associated mitigation measures is outlined in **Table 7-21**.

Table 7-21: Construction Impact on natural vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
The clearing of natural vegetation									
Without Mitigation	3	1	3	4	4	44	Moderate	(-)	Moderate
With Mitigation	3	1	1	3	3	24	Low	(-)	
Mitigation and Management Measures	— Vegetation clearance should be confined to the footprint of the development and unnecessary clearance should be avoided. The severity of the vegetation clearance can be mitigated if only a service road would be cleared and a								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
The clearing of natural vegetation								
	vegetative groundlayer would be retained in the rest of the servitude. — Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns. This includes awareness as to remaining within demarcated construction areas, no littering, handling of pollution and chemical spills, avoiding fire hazards and minimising wildlife interactions. — Ensure that all temporary use areas e.g. laydown areas and construction camp, are located in areas of low sensitivity. — Footprints of the pylons, roads and substation locations should be clearly demarcated. — Watercourses, wetlands, rocky outcrops/sheets should be avoided (Habitats 1 & 7). — Observe buffer zones along drainage lines (see report of aquatic specialist). — All vehicles are to remain on demarcated roads and no driving through the veld should be allowed. — The ECO is to provide supervision on vegetation clearing activities and other activities that may cause damage to the environment, especially when construction commences and most vegetation clearing is taking place. — No plants may be translocated or otherwise uprooted or disturbed without express permission from the ECO.							

THE LOSS OF THREATENED, PROTECTED & ENDEMIC PLANT SPECIES

The loss of the vegetation for the turbines and crane pads, new access roads, upgrading of existing tracks,

construction site and substation may cause a loss of individuals of threatened, protected or endemic plant species. The site visit did however, not reveal the presence of any plant species with an IUCN threatened status and no endemic species are listed for the Soweto Highveld Grassland. Twelve provincially protected plant species were encountered in the region during the site survey, although all have a Least Concern status, except *Gladiolus robertsoniae* which is Near Threatened. However, *Gladiolus robertsoniae* occurs in Habitat 1, which is not affected by the development and furthermore was not recorded on Mukondeleli. As the other protected plant species at the site are not threatened, the loss of a small number of individuals (if any) is not likely to threaten the local or regional populations of these species.

The loss of some individuals of protected species is unlikely to alter the patterns or processes of the natural system, in the sense that environmental functions and processes will temporarily or permanently cease. Nevertheless, permits need to be obtained for the destruction of provincially specially protected or protected species. This impact as well as the associated mitigation measures is outlined in **Table 7-22**.

Table 7-22: Construction Impact on threatened, protected & endemic plant species

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
The loss of threatened protected & endemic plant species									
Without Mitigation	3	1	3	4	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	2	1	3	4	2	**20**	**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
The loss of threatened protected & endemic plant species									
Mitigation and Management Measures	— Placement of infrastructure should be done in such a way as to minimise the impact on protected species. — The construction crew should undergo environmental training (induction) to make them aware of the importance of protected species.								

LOSS OF FAUNAL HABITAT

The loss of the vegetation due to turbines and crane pads, new access roads, upgrading of existing tracks, construction site and substation will be accompanied by a loss of faunal habitat.

Although none of the species listed by the screening tool (avifaunal component excluded) were noted on site, several rare species were reported for the region by the landowners. These include the Near Threatened Serval Leptailurus serval, Southern African hedgehog Atelerix frontalis and the Southern African vlei rat Otomys auratus.

The screening report refers to Crocidura maquassiensis (Maquassie musk shrew) as the species of concern. However, there is a very low probability for it to occur on site. The Lepidopteran species is unlikely to occur on site because its host plant was not recorded there. This impact as well as the associated mitigation measures is outlined in **Table 7-23**.

Table 7-23: Construction Impact on faunal habitat

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of faunal habitat									
Without Mitigation	3	1	3	4	3	33	Moderate	(-)	Moderate
With Mitigation	3	1	1	4	3	27	Low	(-)	
Mitigation and Management Measures	— Vegetation clearance should be confined to the smallest possible footprint of the development and unnecessary clearance should be avoided. — Construction crew should undergo environmental training (induction) to increase their awareness of environmental concerns. — Speed limits should be set on all roads and strictly adhered to. — Development should avoid water courses, wetlands and rocky outcrops/sheets. — Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the sites.								

DIRECT FAUNAL MORTALITIES DUE TO CONSTRUCTION AND INCREASED TRAFFIC

Faunal mortalities may be caused by construction at the footprint of the infrastructure, construction vehicles or other operational activities and by electrical fences, should they be erected around the construction site and substation. In particular slow-moving species such as tortoises, might be prone to these mortalities. When animals ingest waste material or become ensnared in wires, fatalities might also occur.

Larger more mobile fauna such as antelope and larger predators will most likely move away from areas of high activity during the construction phase. Smaller and less-mobile animals are not as capable of moving away and may seek shelter down burrows and other shelter sites. None of the SCC listed in the screening tool were encountered on site and generally these species occur at a low density and thus it is unlikely that they would be directly encountered by people at the the Mukondeleli gridline route. This impact as well as the associated mitigation measures is outlined in **Table 7-24.**

Table 7-24: Construction Impact on t faunal mortalities due to construction and increased traffic

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Direct faunal mortalities due to construction and increased traffic									
Without Mitigation	3	1	3	3	4	**40**	**Moderate**	(-)	Moderate
With Mitigation	2	1	3	2	3	**24**	**Low**	(-)	
Mitigation and Management Measures	— Construction crew, in particular the drivers, should undergo environmental training to increase their awareness of environmental concerns in order to reduce the number of kills during construction and on roads. The crew should also be made aware of not harming or collecting species such as snakes, tortoises and owls. — Proper waste management procedures should be in place to avoid litter, food or other foreign material from lying around and to remove all waste material from the site. — No activity, including night driving, should be allowed at the site after sunset. — Speed limits should be set on all roads on site and strictly adhered to. — Personnel should not be allowed to roam into the veld. — Ensure that cabling and electrical infrastructure at the site are buried sufficiently deeply to avoid being excavated by fauna and that where such infrastructure emerges above-ground that it is sufficiently protected from gnawing animals. — Any dangerous fauna (e.g. snakes, scorpions) that are encountered during construction should not be handled or molested by construction staff and the ECO (or other suitably qualified person) should be contacted to remove the animals to safety. — Holes and trenches should not be left open for extended periods of time and should only be dug when needed for immediate construction. Trenches that may stand open for some days, should have an escape ramp to allow any fauna that fall in to escape. — If there is any part of the site that needs to be lit at night for security reasons, then appropriate lighting should be installed to minimise negative effects on nocturnal animals. — Should electrical fences be erected it must be done according to the norms and standards of the Nature Conservation Authorities in Mpumalanga. — Access to the site should be regulated to reduce the opportunities for poaching.									

INCREASED DUST DEPOSITION

Increased dust deposition may harm physiological processes of plants and a reduction in the photosynthetic capacity of the plants may occur. The dust layer on the vegetation may also discourage herbivores from grazing or browsing. The increased dust levels will however be temporary. This impact as well as the associated mitigation measures is outlined in **Table 7-25**.

Table 7-25: Construction Impact on dust deposition

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased dust deposition									
Without Mitigation	3	1	3	2	4	36	Moderate	(-)	Moderate
With Mitigation	2	1	3	2	2	16	Low	(-)	
Mitigation and Management Measures	— Excessive dust can be reduced by spraying water onto the exposed soil surface.								

INCREASED HUMAN ACTIVITY, NOISE AND LIGHT LEVELS

Construction activities will increase human presence, noise and light levels at the site. These activities may affect animal behaviour. However, increased noise and light levels associated with the construction phase are temporary. This impact as well as the associated mitigation measures is outlined in **Table 7-26**.

Table 7-26: Construction Impact on human activity, noise and light levels

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased human activity, noise and light levels									
Without Mitigation	4	1	3	2	4	40	Moderate	(-)	Moderate
With Mitigation	3	1	3	2	3	27	Low	(-)	
Mitigation and Management Measures	— The SANS standards should be adhered to in terms of noise levels. — No construction should be done at night.								

ESTABLISHMENT OF ALIEN VEGETATION

As a result of the clearance of indigenous vegetation and resulting degradation, alien species might invade the area. Twelve declared alien invasive plant species were recorded on the three Enertrag sites and 35 naturalised species. Another four naturalised alien species were listed by NewPosa for the region.

Six declared invasive species were noted on the Mukondeleli site and increased vehicle traffic may further facilitate the introduction of seeds of alien species. Infestation by invasive alien species may cause changes to the structure and functioning of the ecosystem which often exacerbate the further loss of indigenous vegetation. Bare areas that are not actively rehabilitated and areas receiving runoff are particularly vulnerable to alien infestation. This impact as well as the associated mitigation measures is outlined in **Table 7-27**.

Table 7-27: Construction Impact on alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment of alien vegetation									
Without Mitigation	3	2	3	4	3	36	Moderate	(-)	Moderate
With Mitigation	2	2	3	4	2	22	Low	(-)	
Mitigation and Management Measures	— Implement a monitoring program for the early detection of alien invasive plant species. — A control program should be employed to combat declared alien invasive plant species in the most environmentally friendly manner that does not result in undesirable secondary impacts.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment of alien vegetation									
	— Herbicides for the control of alien species should be applied according to the relevant instructions and by appropriately trained personnel. — No alien species should be used in rehabilitation or landscaping. — Use only plants and seed collected on-site for revegetation. — Cleared areas may need to be fenced-off during rehabilitation to exclude livestock and wildlife. — Material brought onto site e.g. building sand should be regularly checked for the germination of alien species.								

7.7.2 OPERATIONAL PHASE

ESTABLISHMENT OF ALIEN VEGETATION

As a result of the loss of indigenous vegetation and resulting degradation, primarily during the construction phase, alien species might invade the area. Alien invasive species are generally more common in along roads than the adjacent undisturbed farmland. The invasion by alien species will continue unless controlled. Increased vehicle traffic may further facilitate the introduction of seeds of alien species. Infestation by invasive alien species may eventually cause changes to the structure and functioning of the ecosystem which often exacerbate the further loss of indigenous vegetation. This impact as well as the associated mitigation measures is outlined in **Table 7-28**.

Table 7-28: Operation Impact on alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment of alien vegetation									
Without Mitigation	2	2	3	4	2	**22**	**Low**	(-)	Moderate
With Mitigation	1	1	3	4	1	**9**	**Very Low**	(-)	
Mitigation and Management Measures	— Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed. — No alien species should be used for landscaping, rehabilitation or any other purpose. — Clearing of alien species should be done on a regular basis.								

7.7.3 DECOMMISSIONING PHASE

FAUNAL MORTALITIES

Faunal mortalities may be caused by vehicles or other decommissioning activities and waste. In particular slow-moving species such as tortoises, might be prone to road mortalities. When animals ingest waste material or become ensnared in it fatalities might also occur. This impact as well as the associated mitigation measures is outlined in **Table 7-29**.

Table 7-29: Decommissioning Impact on faunal mortalities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Faunal mortalities									
Without Mitigation	1	1	3	2	2	**14**	**Very Low**	(-)	Moderate
With Mitigation	1	1	3	2	2	**14**	**Very Low**	(-)	
Mitigation and Management Measures	— Decommissioning crew should undergo environmental training to increase their awareness of environmental concerns. — Speed limits should be adhered to. — Proper waste management procedures should be in place and no material should be left on site in order to prevent instances of ensnarement or ingestion of foreign material.								

INCREASED DUST DEPOSITION

Increased dust deposition may harm physiological processes of plants and a reduction in the photosynthetic capacity of the plants may occur. The dust layer on the vegetation may also discourage herbivores from grazing or browsing the dust covered vegetation. The increased dust levels will be temporary. This impact as well as the associated mitigation measures is outlined in **Table 7-30**.

Table 7-30: Decommissioning Impact on dust deposition

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased dust deposition									
Without Mitigation	2	2	3	3	2	**20**	**Low**	(-)	Moderate
With Mitigation	1	1	3	3	1	**8**	**Very Low**	(-)	
Mitigation and Management Measures	— Excessive dust can be reduced by spraying water onto the soil.								

ESTABLISHMENT OF ALIEN VEGETATION

As a result of the decommissioning activities, areas will be disturbed and alien species might invade. Increased vehicle traffic may facilitate the introduction of seeds of alien species. This impact as well as the associated mitigation measures is outlined in **Table 7-31**.

Table 7-31: Decommissioning Impact on alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment of alien vegetation									
Without Mitigation	2	2	3	4	2	**22**	**Low**	(-)	Moderate
With Mitigation	1	1	3	4	1	**9**	**Very Low**	(-)	
Mitigation and Management Measures	— Implement a monitoring program for at least three years after decommissioning to document vegetation recovery and alien infestation across the site. — A control program to combat declared alien invasive plant species should be employed. — Areas where infrastructure is removed, must be revegetated with indigenous plant species.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment of alien vegetation									
	— No alien species should be used for rehabilitation/revegetation or any other purpose.								

7.8 AVIFAUNA

7.8.1 CONSTRUCTION PHASE

DISPLACEMENT OF PRIORITY AVIFAUNA DUE TO DISTURBANCE ASSOCIATED WITH THE CONSTRUCTION OF THE ONSITE SUBSTATION AND GRID CONNECTION POWER LINE

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through **disturbance**; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities near breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be very challenging to implement. Terrestrial species and owls are most likely to be affected by displacement due to disturbance in the study area.

The construction impact on priority avifauna due to disturbance during construction of the overhead powerline grid infrastructure is outlined in **Table 7-32**.

Table 7-32: Construction impact on priority avifauna due to disturbance during construction of the overhead powerline grid infrastructure

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement of priority avifauna due to disturbance associated with the construction of the overhead powerline grid infrastructure									
Without Mitigation	4	1	1	2	5	40	Moderate	(-)	Moderate
With Mitigation	3	1	1	2	4	28	Low	(-)	
Mitigation and Management Measures	— Conduct a pre-construction inspection to identify Red List species that may be breeding within the project footprint to ensure that the impacts to breeding species (if any) are adequately managed. — The authorised alignment must be inspected by an avifaunal specialist by means of a “walk-through” inspection i.e., through a combination of satellite imagery supplemented with in situ inspections by vehicle and where necessary, on foot, once the pole positions have been finalised. The objective would be to demarcate the sections of the powerline that need to be fitted with Bird Flight Diverters. — Once the relevant spans have been identified, Bird Flight Diverters must be fitted according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines).								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Displacement of priority avifauna due to disturbance associated with the construction of the overhead powerline grid infrastructure								
	— Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. — Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of powerline sensitive species. — Measures to control noise and dust should be applied according to current best practice in the industry. — Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. — Vegetation clearance should be limited to what is necessary. — The mitigation measures proposed by the biodiversity specialist must be strictly enforced..							

DISPLACEMENT OF PRIORITY SPECIES DUE TO HABITAT TRANSFORMATION AS A RESULT OF THE CONSTRUCTION OF THE ONSITE SUBSTATION AND GRID CONNECTION POWER LINE

During the construction of power lines, service roads (jeep tracks) and substations, habitat destruction/transformation inevitably takes place. The construction activities will constitute the following:

- Site clearance and preparation
- Construction of the infrastructure (i.e., the on-site substation and overhead power line)
- Transportation of personnel, construction material and equipment to the site, and personnel away from the site
- Removal of vegetation for the proposed on-site substation and overhead power line, stockpiling of topsoil and cleared vegetation
- Excavations for infrastructure

Beyond the increased mortality risks to local bird populations posed by such infrastructure, the resulting habitat loss and fragmentation can degrade adjacent habitats, causing either temporary or permanent displacement of bird species from breeding, roosting, and/or foraging habitats (Fletcher et al., 2018). It remains disputed whether habitat fragmentation is always an environmental detriment (Fahrig et al., 2019), yet the impacts of this landscape change are observable in birds. Lane et al. (2001) noted that Great Bustard flocks in Spain were significantly larger further from power lines than at control points. Shaw (2013) found that Ludwig's Bustard in South Africa generally avoid the immediate proximity of roads within a 500m buffer. Bidwell (2004) found that Blue Cranes in South Africa select nesting sites away from roads.

The physical encroachment increases the disturbance and barrier effects that contribute to the overall habitat fragmentation effect of the infrastructure (Raab et al., 2011). It has been shown that fragmentation of natural grassland in Mpumalanga (in that case by afforestation) has had a detrimental impact on the densities and diversity of grassland species (Allan et al., 1997).

The loss of habitat for powerline sensitive species due to direct habitat transformation associated with the construction of the proposed Mukondeleli Grid Connection is likely to be moderate due to the small size of the footprint, but ideally high-quality grassland should be avoided if possible.

The construction impact on priority avifauna d due to habitat change and loss during construction of the overhead powerline grid infrastructure is outlined in **Table 7-33**.

Table 7-33: Construction impact on priority avifauna d due to habitat change and loss during construction of the overhead powerline grid infrastructure

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement of priority species due to habitat transformation as a result of the construction of the overhead powerline grid infrastructure									
Without Mitigation	3	1	3	2	4	**36**	**Moderate**	(-)	Moderate
With Mitigation	2	1	1	2	4	**24**	**Low**	(-)	
Mitigation and Management Measures	— Once the relevant spans have been identified, Bird Flight Diverters must be fitted according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines). — Once the relevant spans have been identified, Bird Flight Diverters must be fitted according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines). — Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. — Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of powerline sensitive species. — Measures to control noise and dust should be applied according to current best practice in the industry. — Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. — Vegetation clearance should be limited to what is necessary. — The mitigation measures proposed by the biodiversity specialist must be strictly enforced.								

7.8.2 OPERATIONAL PHASE

ELECTROCUTION OF PRIORITY SPECIES IN SUBSTATIONS

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen, 2004). The electrocution risk is largely determined by the pole/tower design. In the case of the proposed 132kV grid connection, the electrocution risk is envisaged to be negligible because of the clearance distances between the live and earthed components inherent in the design of such powerlines. The 132kV grid connection power line should not pose an electrocution threat to the powerline sensitive species which are likely to occur in the PAOI and immediate surrounding environment.

Electrocutions within the proposed on-site substation yard are possible but should not affect the more sensitive Red List bird species, as these species are unlikely to use the infrastructure within the substation yard for perching or roosting. Species that are more vulnerable to this impact are corvids, owls, and certain species of waterbirds.

The operation impact on mortality of priority avifauna due due to electrocution in substations is outlined in **Table 7-34**.

Table 7-34: Operation impact on mortality of priority avifauna due to electrocution in substations

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Electrocution mortality in the substations									
Without Mitigation	5	2	3	4	4	**56**	**High**	(-)	Moderate
With Mitigation	5	2	3	4	1	**14**	**Very Low**	(-)	
Mitigation and Management Measures	— The hardware within the proposed substation yard is too complex and the risk too low to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded by the maintenance staff once operational, site-specific mitigation (insulation) be applied reactively if need be. This is an acceptable approach because Red List powerline sensitive species are unlikely to frequent the substation, although some more common powerline sensitive species might well be present more often and exposed to the electrocution risk								

COLLISION MORTALITY OF PRIORITY SPECIES WITH THE OVERHEAD 132KV POWERLINES IN THE OPERATIONAL PHASE.

Collisions are arguably the biggest threat posed by transmission lines to birds in southern Africa (van Rooyen, 2004). Most heavily impacted upon are bustards, storks, cranes, and various species of waterbirds, and to a lesser extent, vultures. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (van Rooyen, 2004). In a PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with transmission lines:

"The collision risk posed by power lines is complex and problems are often localised. While any bird flying near a power line is at risk of collision, this risk varies greatly between different groups of birds, and depends on the interplay of a wide range of factors described these factors in four main groups – biological, topographical, meteorological, and technical. Birds at highest risk are those that are both susceptible to collisions and frequently exposed to power lines, with waterbirds, gamebirds, rails, cranes, and bustards usually the most numerous reported victims.

The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk. These birds must fly fast to remain airborne, and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the lower-resolution, and often restricted, forward vision that is useful to detect obstacles. Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision. Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often. Juvenile birds have often been reported as being more collision-prone than adults.

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g., those that separate feeding and roosting areas, or cross flyways) can be very dangerous. Lines crossing the prevailing wind conditions can pose a problem for large birds that use the wind to aid take-off and landing. Inclement weather can disorient birds and reduce their flight altitude, and strong winds can result in birds colliding with power lines that they can see but do not have enough flight control to avoid.

The technical aspects of power line design and siting also play a big part in collision risk. Grouping similar power lines on a common servitude or locating them along other features such as tree lines, are both approaches thought to reduce risk. In general, low lines with short span lengths (i.e., the distance between two adjacent pylons) and flat conductor configurations are thought to be the least dangerous. On many higher voltage lines, there is a thin earth (or ground) wire above the conductors, protecting the system from lightning strikes. Earth wires are widely accepted to cause most collisions on power lines with this configuration because *they are difficult to see, and birds flaring to avoid hitting the conductors often put themselves directly in the path of these wires."*

From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa.

Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and power line configuration. An important additional factor that previously has received little attention is the visual capacity of birds, i.e., whether they are able to see obstacles such as power lines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is key to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin et al., 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with power lines i.e. Kori Bustards *Ardeotis kori*, Blue Cranes and White Storks *Ciconia ciconia*. In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward-facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35°, respectively, are sufficient to render the birds blind in the direction of travel; in storks, head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and power lines. These findings have applicability to species outside of these families especially raptors (A*ccipitridae*) which are known to have small binocular fields and large blind areas like those of bustards and cranes and are also known to be vulnerable to power line collisions.

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins et al., 2010; Martin et al., 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (Alonso & Alonso, 1999; Barrientos et al., 2011; Bernardino et al., 2018; Jenkins et al., 2010; Koops & De Jong, 1982; Sporer et al., 2013), including to some extent for bustards (Barrientos et al., 2012; Hoogstad 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos et al. (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10m intervals only reduces the mortality by 57%. Barrientos et al. (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin et al., 2010).

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing power line collision mortalities of large birds on three up to 400kV transmission lines near Hydra substation in the Karoo. Marking was highly effective for Blue Cranes, with a 92% reduction in mortality, and large birds in general with a 56% reduction in mortality, but not for bustards, including the endangered Ludwig's Bustard. The two different marking devices were approximately equally effective, namely spirals and bird flappers, they found no evidence supporting the preferential use of one type of marker over the other (Shaw et al., 2017).

The operation impact on mortality of priority avifauna due to collisions overhead 132kV powerlines is outlined in **Table 7-35**.

Table 7-35: Operation impact on mortality of priority avifauna due to collisions with the overhead 132kV powerlines

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Bird mortality and injury resulting from collisions with the 132kV powerline									
Without Mitigation	5	2	3	4	4	56	High	(-)	Moderate
With Mitigation	5	2	3	4	2	28	Low	(-)	
Mitigation and Management Measures	— The hardware within the proposed substation yard is too complex and the risk too low to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded by the maintenance staff once operational, site-specific mitigation (insulation) be applied reactively if need be. This is an acceptable approach because Red List powerline sensitive species are unlikely to frequent the substation, although some more common powerline sensitive species might well be present more often and exposed to the electrocution risk								

7.8.3 DECOMMISSIONING PHASE

DISPLACEMENT OF PRIORITY AVIFAUNA DUE TO DISTURBANCE ASSOCIATED WITH DECOMMISSIONING OF THE ONSITE SUBSTATION AND GRID CONNECTION POWER LINE

The decommissioning impact on mortality of priority avifauna due to collisions with the medium voltage overhead lines is outlined in **Table 7-36.**

Table 7-36: Decommissioning impact on priority avifauna due decommissioning of the onsite substation and grid connection power line

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement of priority avifauna due to disturbance associated with the dismantling of the 132kV grid infrastructure.									
Without Mitigation	4	1	1	2	5	40	Moderate	(-)	Moderate
With Mitigation	3	1	1	2	4	28	Low	(-)	
Mitigation and Management Measures	— Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible. — Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of powerline sensitive species. — Measures to control noise and dust should be applied according to current best practice in the industry. — Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum..								

7.9 VISUAL AND LANDSCAPE

7.9.1 CONSTRUCTION PHASE

Large construction vehicles, equipment and construction material stockpiles will alter the natural character of the study area and expose visual receptors to impacts associated with construction. Construction activities may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Temporary stockpiling of soil during construction may alter the flat landscape. Wind blowing over these disturbed areas could result in dust which would have a visual impact.

Dust emissions and dust plumes from increased traffic on the gravel roads serving the construction site may evoke negative sentiments from surrounding viewers.

Surface clearance for cable trenches, access roads, laydown areas and other on-site infrastructure may result in the increased visual prominence of these features, thus increasing the level of contrast with the surrounding landscape. Potential visual pollution could also result from littering on the construction site.

The construction visual impact as well as mitigation measures are indicated in **Table 7-37**.

Table 7-37: Construction Impact on the visual receptors of the Mukondeleli EGI Project

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impact due to construction									
Without Mitigation	3	2	3	2	2	**30**	**Low**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	

Mitigation and Management Measures	— Carefully plan to minimise the construction period and avoid construction delays.
	— Where possible restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
	— Position storage/stockpile areas in unobtrusive positions in the landscape, where possible.
	— Minimise vegetation clearing and rehabilitate cleared areas as soon as possible.
	— Vegetation clearing should take place in a phased manner.
	— Make use of existing gravel access roads where possible.
	— Limit the number of vehicles and trucks travelling to and from the construction site, where possible.
	— Ensure that suitable dust suppression techniques are implemented:
	  — on all access roads;
	  — in all areas where vegetation clearing has taken place;
	  — on all soil stockpiles.
	— Maintain a neat construction site by removing litter, rubble and waste materials regularly.								

7.9.2 OPERATIONAL PHASE

The proposed power line and substation could alter the visual character of the surrounding area and expose sensitive visual receptor locations to visual impacts. The proposed development will alter the visual character of the surrounding area and expose potentially sensitive visual receptor locations to visual impacts.

Dust emissions and dust plumes from maintenance vehicles accessing the site via gravel roads may evoke negative sentiments from surrounding viewers. The night time visual environment will be altered as a result of operational and security lighting at the proposed substation. The impact assessment for the above-mentioned impacts is outlined in **Table 7-38**.

Table 7-38: Operational Impact on the visual receptors of the Mukondeleli EGI Project

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impact of wind turbines and associated infrastructure									
Without Mitigation	2	3	3	4	2	**24**	**Low**	(-)	Moderate
With Mitigation	2	3	3	4	2	**24**	**Low**	(-)	
Mitigation and Management Measures	— Where possible, limit the number of maintenance vehicles using access roads. — Ensure that dust suppression techniques are implemented on all gravel access roads. — As far as possible, limit the amount of security and operational lighting present on the substation site whilst adhering to safety standards. — Light fittings for security at night should reflect the light toward the ground and prevent light spill. — Lighting fixtures should make use of minimum lumen or wattage whilst adhering to safety standards. — Mounting heights of lighting fixtures should be limited, or alternatively foot-light or bollard level lights should be used. — If possible, make use of motion detectors on security lighting. — The buildings on the substation site should not be illuminated at night unless required to adhere to safety standards and should be painted in natural tones that fit with the surrounding environment. — Non-reflective surfaces should be used where possible.								

7.9.3 DECOMMISSIONING PHASE

Vehicles and equipment required for decommissioning will alter the natural character of the study area and expose visual receptors to visual impacts. Decommissioning activities may be perceived as an unwelcome visual intrusion. Dust emissions and dust plumes from increased traffic on the gravel roads serving the decommissioning site may evoke negative sentiments from surrounding viewers. Surface disturbance during construction would expose bare soil resulting in visual scarring of the landscape and increasing the level of visual contrast with the surrounding environment. Temporary stockpiling of soil during decommissioning may alter the flat landscape. Wind blowing over these disturbed areas could result in dust which would have a visual impact.

The impact assessment for the above-mentioned decommissioning impacts is outlined in **Table 7-39**.

Table 7-39: Decommissioning Impact on the visual receptors

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impact due to decommissioning									
Without Mitigation	3	2	3	2	2	**30**	**Low**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— All infrastructure that is not required for post-decommissioning use should be removed. — Carefully plan to minimize the decommissioning period and avoid delays. — Maintain a neat decommissioning site by removing rubble and waste materials regularly. — Position storage / stockpile areas in unobtrusive positions in the landscape, where possible.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impact due to decommissioning									
	— Ensure that dust suppression procedures are maintained on all gravel access roads throughout the decommissioning phase. — All cleared areas should be rehabilitated as soon as possible.								

7.10 HERITAGE AND CULTURAL RESOURCES

7.10.1 CONSTRUCTION PHASE

IMPACTS TO ARCHAEOLOGICAL RESOURCES

Direct impacts to archaeological resources would only occur during the construction phase when grubbing and construction commence. Due to the presence of one culturally significant site in the centre of the corridor, the impact significance calculates to **high negative** if one assumes that the site would be destroyed. Mitigation would entail surveying the as yet unsurveyed areas of the final alignment south of 26°36’24”S (but arable lands need not be covered), micrositing of infrastructure as required to avoid any newly recorded sites as well as reporting any further sites discovered during construction. With mitigation, the significance reduces to **very low negative**.

The construction impacts as well as the mitigation measures are outlined in **Table 7-40**.

Table 7-40: Construction Impact on archaeological resources

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Damage to or destruction of archaeological resources									
Without Mitigation	3	2	5	5	5	**75**	**High**	(-)	High
With Mitigation	1	1	5	5	1	**12**	**Very Low**	(-)	
Mitigation and Management Measures	— Surveying the as yet unsurveyed areas (but arable lands need not be covered) — Micrositing of infrastructure as required to avoid any impacts as well as reporting any further sites discovered during construction								

IMPACTS TO GRAVES

No graves or possible graves have been recorded within the corridor but there is always the chance that a grave could come to light at a later stage (the probability is still low though). Because of the very high cultural significance of graves the magnitude of impacts to graves is rated high. The resulting impact significance is **medium negative**. Mitigation will entail avoiding all graves and potential graves and reporting any chance finds of unmarked graves during construction. A pre-construction survey should also be undertaken to determine whether any graves are visible in the final footprint. Once again, this only needs to occur south of 26°36’24”S (but arable lands need not be covered). With mitigation the significance would reduce to **very low negative**. There are no fatal flaws in terms of construction phase impacts to graves.

The construction impacts as well as the mitigation measures are outlined in**Table 7-41**.

Table 7-41: Construction Impact on graves

Potential Impact Damage to or destruction of graves	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	5	1	5	5	2	32	Moderate	(-)	High
With Mitigation	1	1	5	5	1	12	Very Low	(-)	
Mitigation and Management Measures	— Avoid all graves and potential graves — Report any chance finds of unmarked graves during construction — A pre-construction survey should also be undertaken to determine whether any graves are visible in the final footprint.								

IMPACTS TO THE CULTURAL LANDSCAPE

The local landscape is already heavily compromised by the nearby Sasol facility and coal mines. As such, the intrusion into this landscape of the construction equipment is considered to be of low magnitude. Due to the certainty of an impact occurring, the significance calculates to **moderate negative**. Minimising the construction duration, minimising landscape disturbance in general and ensuring rehabilitation of areas not needed during operation will reduce impacts, but the rating is still **moderate negative**. A rating of **low negative**, however, is considered a better fit considering the existing impacts to the landscape.

The construction impacts as well as the mitigation measures are outlined in **Table 7-42**.

Table 7-42: Construction Impact on cultural landscapes

Potential Impact Visual intrusion into and change of character of the cultural landscape	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	1	2	3	2	5	40	Moderate	(-)	High
With Mitigation	1	2	3	2	5	40	Moderate	(-)	
Mitigation and Management Measures	— Minimising the construction duration — Minimising landscape disturbance in general and ensuring rehabilitation of areas not needed during operation								

7.10.2 OPERATIONAL PHASE

IMPACTS TO THE CULTURAL LANDSCAPE

As before, the local landscape is already heavily compromised by the nearby Sasol facility and coal mines. As such, the intrusion into this landscape of the infrastructure is considered to be of only low magnitude. Due to the certainty of an impact occurring, the significance calculates to **moderate negative**. There are no specific mitigation measures that can be applied during operation other than the best practice measure of ensuring that all maintenance work occurs within designated areas. Post-mitigation significance would remain at the **moderate negative** level. A rating of **low negative**, however, is considered a better fit considering the existing impacts to the landscape. There are no fatal flaws in terms of operation phase impacts to the cultural landscape.

The construction impacts as well as the mitigation measures are outlined in **Table 7-43**.

Table 7-43: Operation Impact on cultural landscapes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual intrusion into and change of character of the cultural landscape									
Without Mitigation	1	2	3	4	5	**50**	**Moderate**	(-)	High
With Mitigation	1	2	3	4	5	**50**	**Moderate**	(-)	
Mitigation and Management Measures	— There are no specific mitigation measures that can be applied during operation other than the best practice measure of ensuring that all maintenance work occurs within designated areas								

7.10.3 DECOMMISSIONING PHASE

Once again, because the local landscape is compromised by the Sasol facility and coal mines, the intrusion into this landscape of the equipment needed for decommissioning is considered to be of low magnitude. The significance calculates to moderate negative. Minimising the decommissioning duration and ensuring full rehabilitation post-closure will not result in a change to the calculated significance which remains moderate negative. A rating of low negative, however, is considered a better fit considering the existing impacts to the landscape. There are no fatal flaws in terms of operation phase impacts to the cultural landscape.

The construction impacts as well as the mitigation measures are outlined in **Table 7-44**.

Table 7-44: Decommissioning Impact on cultural landscapes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual intrusion into and change of character of the cultural landscape									
Without Mitigation	1	2	3	2	5	**40**	**Moderate**	(-)	High
With Mitigation	1	2	3	2	5	**40**	**Moderate**	(-)	
Mitigation and Management Measures	— Minimising the decommissioning duration — Ensuring full rehabilitation post-closure will not result in a change to the calculated significance which remains moderate negative								

7.11 PALAEONTOLOGY

7.11.1 CONSTRUCTION PHASE

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are mostly the wrong kind to contain fossils (dolerite and covering soils. Since there is a small chance that fossils may occur below ground in the Vryheid Formation and may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

The construction impacts as well as the mitigation measures are outlined in **Table 7-45**.

Table 7-45: Construction Impact on palaeontological resources

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Damage to or destruction of archaeological resources									
Without Mitigation	1	1	5	5	1	12	Very Low	(-)	High
With Mitigation	1	1	5	5	1	12	Very Low	(-)	
Mitigation and Management Measures	— Implementation of a chance finds procedure on site.								

7.11.2 OPERATIONAL PHASE

The operational phase will not impact the palaeontology.

7.11.3 DECOMMISSIONING PHASE

The operational phase will not impact the palaeontology.

7.12 SOCIAL

7.12.1 CONSTRUCTION PHASE

CREATION OF LOCAL EMPLOYMENT, TRAINING, AND BUSINESS OPPORTUNITIES

The construction phase is expected to extend over a period of approximately 6-12 months and create in the region of 30employment opportunities. Approximately 80% of the jobs will be low-skilled, 15% semi-skilled and 5% skilled. Most of the low and semi-skilled employment opportunities would benefit community members from local towns in the area. A percentage of the wage bill will be spent in the local economy which will also create opportunities for local businesses in the local towns in the area.

The capital expenditure associated with the construction of grid infrastructure will be ~ R 65 million and will create opportunities for local companies and the regional and local economy. Implementing the enhancement measures listed below can enhance these opportunities. The sector of the local economy that is most likely to benefit from the proposed development is the local service industry. The potential opportunities for the local service sector would be linked to accommodation, catering, cleaning, transport, and security, etc. associated with the construction workers on the site. However, given the relatively small scale of the project and short duration of the construction phase these benefits will be limited. The construction impact of employment, training and business creation opportunities is outlined in **Table 7-46.**

Table 7-46: Construction Impact of employment, skills development, and business creation opportunities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Creation of employment and business opportunities									
Without Mitigation	2	2	N/A	2	3	18	Low	(+)	Easy
With Mitigation	4	2	N/A	2	4	32	Moderate	(+)	
Mitigation and Management Measures	**Employment** — Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Creation of employment and business opportunities								
	— Where reasonable and practical, the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area. — Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria. — Before the construction phase commences the proponent should meet with representatives from the MM to establish the existence of a skills database for the area. If such as database exists, it should be made available to the contractors appointed for the construction phase. — The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project. — Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase. — The recruitment selection process should seek to promote gender equality and the employment of women wherever possible. **Business** — The proponent should liaise with the MM with regards the establishment of a database of local companies, specifically BBBEE companies, which qualify as potential service providers (e.g., construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction service providers. These companies should be notified of the tender process and invited to bid for project-related work.							

IMPACT OF CONSTRUCTION WORKERS ON LOCAL COMMUNITIES

The presence of construction workers can pose a potential risk to family structures and social networks. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on local communities. The most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to potentially risky behaviour, mainly of male construction workers, including:

— An increase in alcohol and drug use.
— An increase in crime levels.
— The loss of girlfriends and/or wives to construction workers.
— An increase in teenage and unwanted pregnancies.
— An increase in prostitution.
— An increase in sexually transmitted diseases (STDs), including HIV.

Given the relatively small number of construction workers, namely ~ 30-50, the potential impact on the local community is likely to be negligible. The construction impact on local communities due to construction workers in the area is outlined in **Table 7-47**.

Table 7-47: Construction Impact of the presence of construction workers in the area on local communities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Impacts on family structures and social networks associated with the presence of construction workers									
Without Mitigation	2	2	3	2	2	18	Low	(-)	Moderate
With Mitigation	1	1	3	2	2	14	Low	(-)	
Mitigation and Management Measures	— Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. — Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. — The SEP and CHSSP should include a Grievance Mechanism that enables stakeholders to report resolve incidents. — Where possible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically for semi and low-skilled job categories. — The proponent should consider the option of establishing a Monitoring Committee (MC) for the construction phase that representatives from local landowners, farming associations, and the local municipality. This MC should be established prior to commencement of the construction phase and form part of the SEP. — The proponent and contractor should develop a Code of Conduct (CoC) for construction workers. The code should identify which types of behaviour and activities are not acceptable. Construction workers in breach of the code should be subject to appropriate disciplinary action and/or dismissed. All dismissals must comply with the South African labour legislation. The CoC should be signed by the proponent and the contractors before the contractors move onto site. The CoC should form part of the CHSSP. — The proponent and the contractor should implement an HIV/AIDS, COVID-19 and Tuberculosis (TB) awareness programme for all construction workers at the outset of the construction phase. The programmes should form part of the CHSSP. — The contractor should provide transport for workers to and from the site on a daily basis. This will enable the contactor to effectively manage and monitor the movement of construction workers on and off the site. — The contractor must ensure that all construction workers from outside the area are transported back to their place of residence within 2 days for their contract coming to an end. — No construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.									

RISK TO SAFETY, LIVESTOCK, AND FARM INFRASTRUCTURE

The presence of and movement of construction workers on and off the site poses a potential safety threat to local famers and farm workers in the vicinity of the site. In addition, farm infrastructure, such as fences and gates, may be damaged and stock losses may also result from gates being left open. The presence of construction workers on the site also increases the exposure to local farming operations to the outside world, which, in turn, increases the potential risk of stock theft.

The potential risks (safety, livestock, and farm infrastructure) can be effectively mitigated by careful planning and managing the movement of construction workers on the site during the construction phase. The mitigation measures to address these risks are outlined below. The construction impact if risk to safety, livestock, and damage to farm infrastructure is outlined in **Table 7-48**.

Table 7-48: Construction Impact of risk to safety, livestock and damage to farm infrastructure

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Risk to safety, livestock and damage to farm infrastructure									
Without Mitigation	3	2	3	2	3	**30**	**Moderate**	(-)	Easy
With Mitigation	2	1	3	2	3	**16**	**Low**	(-)	
Mitigation and Management Measures	— Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. — Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. — The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. The agreement should be signed before the construction phase commences. — All farm gates must be closed after passing through. — Contractors appointed by the proponent should provide daily transport for low and semi-skilled workers to and from the site. — The proponent should establish a MC and CoC for workers (see above). — The proponent should hold contractors liable for compensating farmers and communities in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors, and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below). — The proponent should implement a Grievance Mechanism that provides local farmers with an effective and efficient mechanism to address issues related to report issues related to damage to farm infrastructure, stock theft and poaching etc. — The Environmental Management Plan (EMP) must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested. — Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained in the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms. — Contractors appointed by the proponent must ensure that construction workers who are found guilty of stealing livestock and/or damaging farm infrastructure are dismissed and charged. This should be contained in the CoC. All dismissals must be in accordance with South African labour legislation. — It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.									

NUISANCE IMPACTS ASSOCIATED WITH CONSTRUCTION RELATED ACTIVITIES

Construction related activities, including the movement of heavy construction vehicles of and on the site, has the potential to create dust, noise and safety impacts and damage to local roads. Given the relatively small number of construction workers and the short construction period the traffic related impacts are likely to be limited. The impacts will be largely local and can be effectively mitigated. The assessment of the nuisance impacts associated with construction related activities is outlined in **Table 7-49.**

Table 7-49: Construction Impact of noise, dust and safety

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Noise, dust and safety impacts associated with movement of construction related activities and movement of traffic to and from the site									
Without Mitigation	2	2	1	2	3	21	Low	(-)	Easy
With Mitigation	2	1	1	2	2	12	Low	(-)	
Mitigation and Management Measures	— Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. — Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. — Timing of construction activities should be planned to avoid / minimise impact on key farming activities, including planting and harvesting operations. — The proponent should establish a MC to monitor the construction phase and the implementation of the recommended mitigation measures. The MC should be established before the construction phase commences, and should include key stakeholders, including representatives from local farmers and the contractor(s). The MF should also address issues associated with damage to roads and other construction related impacts. — Ongoing communication with land owners and road users during construction period. This should be outlined in the SEP. — The proponent should implement a Grievance Mechanism that provides local farmers and other road users with an effective and efficient mechanism to address issues related to construction related impacts, including damage to local gravel farm roads. — Implementation of a road maintenance programme throughout the construction phase to ensure that the affected roads maintained in a good condition and repaired once the construction phase is completed. — Repair of all affected road portions at the end of construction period where required. — Dust suppression measures must be implemented on un-surfaced roads, such as wetting on a regular basis and ensuring that vehicles used to transport building materials are fitted with tarpaulins or covers. — All vehicles must be roadworthy, and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.									

INCREASED RISK OF VELD FIRE

The presence on and movement of construction workers on and off the site and construction related activities such as welding etc., increases the risk of veld fires which pose a risk to livestock, farm infrastructure and crops. The loss of grazing also poses a threat to local livelihoods that are dependent on livestock farming. The risk of veld fires is higher during the dry, windy winter months of May through to November. The construction impact of veld fires to livestock, farm infrastructure and grazing is outlined in **Table 7-50**.

Table 7-50: Construction Impact of risk posed by veld fires

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of livestock and grazing and damage to farm infrastructure associated with increased incidence of grass fires									
Without Mitigation	3	2	3	2	3	**30**	**Moderate**	(-)	Easy
With Mitigation	2	1	3	2	2	**16**	**Low**	(-)	
Mitigation and Management Measures	— Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. — Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. — The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc., during the construction phase will be compensated for. The agreement should be signed before the construction phase commences. — Contractor should ensure that open fires on the site for cooking or heating are not allowed except in designated areas. — Smoking on site should be confined to designated areas. — Contractor should ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced. Measures to reduce the risk of fires include avoiding working in high wind conditions when the risk of fires is greater. In this regard special care should be taken during the high risk dry, windy summer months. — Contractor should provide adequate fire-fighting equipment on-site, including a fire fighting vehicle. — Contractor should provide fire-fighting training to selected construction staff. As per the conditions of the Code of Conduct, in the advent of a fire being caused by construction workers and or construction activities, the appointed contractors must compensate farmers for any damage caused to their farms. The contractor should also compensate the fire-fighting costs borne by farmers and local authorities. — No construction staff, with the exception of security staff, to be accommodated on site overnight.								

IMPACTS ASSOCIATED WITH LOSS OF FARMLAND

The activities associated with the construction phase and establishment of the proposed project and associated infrastructure will result in the disturbance and loss of land available for grazing. The impact on farmland associated with the construction phase can be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase. In addition, the landowner will be compensated for the loss of land.

Based on feedback from the affected land owners, Alternative 2 is preferred by the relevant land owner. This is due to substation site Alternative 2 being closely located, within <250 m, from the residential cluster on Van Tondershoek (317/12), and at the entrance to the property. Alternative 2 line would furthermore traverse cropped fields. This is undesirable, as it would restrict ease of tilling and result in (moderate) footprint losses of scarce tillable land. Alternative 1 substation (preferred) is regarded as acceptable, as deemed sufficiently distant from residential structures on the Joubert properties, and does not impact on crop land (Joubert, pers. comm)

The owners also indicated that the portion of the common alignment impacts on the cropped area on Bosjesspruit 291/8 and was not preferable. The impact could be mitigated by re-aligning the segment to the east so that it follows the cadastral boundary with 291/9, i.e., just to the easy of the cropping area (Joubert, pers. comm). The construction impact on farmlands is outlined in **Table 7-51**.

Table 7-51: Construction Impact on farmlands

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Impact on productive farmland									
Without Mitigation	3	2	3	2	4	**40**	**Moderate**	(-)	Easy
With Mitigation	2	1	3	2	3	**24**	**Low**	(-)	
Mitigation and Management Measures	— The loss of high-quality agricultural land should be avoided and or minimised by careful planning of the final layout of the proposed transmission line. Based on the comments from the landowners the portion of the common alignment should be relocated to the east so that it follows the cadastral boundary with 291/9[9]. — The recommendations of the agricultural / soil assessment should be implemented. — Affected landowners should be consulted about the timing of construction related activities in advance. — The footprint associated with the construction related activities (access roads, construction platforms, workshop etc.) should be minimised. — An Environmental Control Officer (ECO) should be appointed to monitor the establishment phase of the construction phase. — All areas disturbed by construction related activities, such as access roads on the site, construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase. — The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed. The specifications for the rehabilitation programme should be drawn up by the Environmental Consultants appointed to manage the EIA. — The implementation of the Rehabilitation Programme should be monitored by the ECO — .									

7.12.2 OPERATIONAL PHASE

PROVIDE ENERGY INFRASTRUCTURE TO SUPPORT THE USE OF RENEWABLE ENERGY TO PRODUCE GREEN HYDROGEN AND AMMONIA

The proposed power line is essential for the operation of the Mukondeleli WEF. The objective of the WEF is to generate renewable energy to produce commercially usable green hydrogen and ammonia that can be used as a fuel for transport in hydrogen fuel cells and or in different industrial uses. The ammonia will be primarily used for the production of ammonium nitrate (fertiliser) and manufacture of plastics, explosives, textiles, pesticides, and other chemicals. Ammonia can also be used as a stable ‘carrier’ of hydrogen, allowing hydrogen to be readily stored and transported. The proposed project will therefore create opportunities to improve energy

[9] As indicated above, ENERTRAG South Africa has met with the affected landowners to address the issues raised. The alignment can be accommodated within the 200m corridor that is being assessed.

security in South Africa by generating alternative energy sources and reduce the carbon footprint associated with current energy generation. The project will also produce green ammonium nitrate for the South African farming and industrial sector and support the transmission of South Africa's fossil fuel-based economy to renewable energy. The operational impact of the development of infrastructure to generate renewable energy to produce green hydrogen and ammonia is outlined in **Table 7-52**.

Table 7-52: Operational Impact of development of infrastructure to improve energy security and support the renewable sector

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Generate renewable energy to produce green hydrogen and ammonia									
Without Mitigation	3	4	N/A	4	4	**44**	**Moderate**	(-)	Easy
With Mitigation	3	4	N/A	4	5	**55**	**Moderate**	(+)	
Mitigation and Management Measures	— Maximise the number of employment opportunities for local community members, where feasible. — Implement training and skills development programs for members from the local community. — Maximise opportunities for local content and procurement.								

CREATION OF EMPLOYMENT AND BUSINESS OPPORTUNITIES

The potential employment, skills development and business-related opportunities associated with the power line and substation will be limited and largely confined to periodic maintenance and repairs. The potential socio-economic benefits are therefore likely to be limited. There is limited opportunity to enhance the potential opportunities. The operational impact of employment, skills development and business creation opportunities is outlined in **Table 7-53**.

Table 7-53: Operational Impact of employment, skills development and business opportunities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Creation of employment, skills development and business opportunities									
Without Mitigation	2	1	N/A	4	4	**28**	**Low**	(+)	Easy
With Mitigation	2	1	N/A	4	4	**28**	**Low**	(+)	
Mitigation and Management Measures	**Employment** — Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the operational phase. — Where reasonable and practical, the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area. — Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria. — Before the construction phase commences the proponent should meet with representatives from the MM to establish the existence of a skills database for the area. If such as database exists, it should be made available to the contractors appointed for the construction phase. — The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment								

Potential Impact **Creation of employment, skills development and business opportunities**	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
	procedures that the proponent intends following for the construction phase of the project. — Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase. — The recruitment selection process should seek to promote gender equality and the employment of women wherever possible. **Business** — The proponent should liaise with the MM with regards the establishment of a database of local companies, specifically BBBEE companies, which qualify as potential service providers (e.g., construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction service providers. These companies should be notified of the tender process and invited to bid for project-related work									

GENERATE INCOME FOR AFFECTED LANDOWNERS

The proponent will enter into rental agreements with the affected landowners for the use of the land for the establishment of the proposed WEF. In terms of the rental agreement the affected landowner will be paid an annual amount dependent upon the area affected. The additional income will reduce the risk to his livelihoods posed by droughts and fluctuating market prices for farm outputs and farming inputs, such as fuel, feed etc. The additional income represents a significant benefit for the affected landowner. The operational impact of benefits associated with income generated for affected farmers is outlined in **Table 7-54**.

Table 7-54: Operational Impact of benefits associated with income generated for affected farmers

Potential Impact **Generation of additional income for affected farmers**	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	1	N/A	4	3	21	Low	(+)	Easy
With Mitigation	3	2	N/A	4	5	45	Moderate	(+)	
Mitigation and Management Measures	— Implement agreements with affected landowners. — The loss of high-quality agricultural land should be avoided and or minimised by careful planning in the final layout of the proposed WEF facilities, where possible.								

VISUAL IMPACT AND IMPACT ON SENSE OF PLACE

The proposed WEF has the potential to impact on the areas existing rural sense of place. However, given the location of the site next to the existing, large Secunda petrochemical facility and associated coal mines the potential impact on the areas sense of place is likely to be limited. This was confirmed during the site visit. None of affected landowners or adjacent owners interviewed raised concerns regarding the potential impact on the areas sense of place. The visual impact and impact on sense of place associated with the proposed facility and associated infrastructure is outlined in **Table 7-55**.

Table 7-55: Visual impact and impact on sense of place during the operational phase

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impact and impact on the areas rural sense of place									
Without Mitigation	3	2	1	4	3	33	Moderate	(-)	Easy
With Mitigation	2	2	1	4	3	27	Low	(-)	
Mitigation and Management Measures	— Alternative 2, which is associated with substation 2 is not regarded as suitable due to the proximity of the substation to the residential cluster on Van Tondershoek (317/12) and at the entrance to the property. — Recommendations of the VIA should be implemented.								

IMPACT ON FARMING OPERATIONS DURING MAINTENANCE

The presence on and movement of maintenance workers on and off the site poses a potential risk to farming operations. Farm fence and gates may be damaged and stock losses may also result from gates being left open. The presence of maintenance workers on the site also increases the exposure of their farming operations and livestock to the outside world, which, in turn, increased the potential risk of stock theft and crime.

The key issues raised are linked to the construction phase but are also valid for the maintenance phase. These include:

- Impact of maintenance related activities and movement of maintenance vehicles on the cropped areas and the veld.
- Farm gates left open by maintenance contractors.
- Damage to farm fences. The damage to farm fences poses the same risks to farming operations as leaving farm gates open.
- Lack of awareness amongst contractors of the impacts that their activities can have on farming operations.

Based on experience with maintenance of the existing Eskom power lines this is an issue that will need to be addressed. The potential risks (safety, livestock, and farm infrastructure) can be effectively mitigated by ensuring the maintenance teams take care to ensure that gates are kept closed and affected property owners are kept informed about timing of maintenance operations. The operational impact on farming operations is outlined in **Table 7-56**.

Table 7-56: Operational impact on property values

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impact and impact on property values									
Without Mitigation	3	2	3	2	4	40	Moderate	(-)	Easy
With Mitigation	2	2	3	2	3	27	Low	(-)	
Mitigation and Management Measures	— Affected property owners should be notified in advance of the timing and duration of maintenance activities. — Maintenance teams must ensure that all farm gates must be closed after passing through. — Property owners should be compensated for damage to farm property and or loss of livestock or game associated maintenance related activities.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Visual impact and impact on property values								
	— Movement of traffic and maintenance related activities should be strictly contained within designated areas associated with transmission lines and substations. — Strict traffic speed limits must be enforced on the farm. — No maintenance workers should be allowed to stay over-night on the affected properties							

7.13 HEALTH, SAFETY AND RISK

A high-level Safety Health and Environmental Risk Assessment was undertaken for the proposed development of Battery Energy Storage Systems (BESS) associated with the proposed Mukondeleli WEF, Secunda, Mpumalanga

7.13.1 CONSTRUCTION PHASE

SOLID STATE LITHIUM-ION BATTERY ENERGY STORAGE SYSTEMS

HUMAN HEALTH - CHRONIC EXPOSURE TO TOXIC CHEMICAL OR BIOLOGICAL AGENTS

Exposure to materials such as cement, paints, solvents, welding fumes, truck fumes etc. during construction can result in employee / contractor illness. The construction impact associated with chronic exposure to toxic chemical or biological agents is outlined in **Table 7-57**.

Table 7-57: Construction Impact on Human Health chronic exposure to toxic chemical or biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Chronic exposure to toxic chemical or biological agents									
Without Mitigation	3	1	3	4	4	**44**	**Moderate**	(-)	Moderate
With Mitigation	1	1	3	4	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— The construction phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. — A SHEQ policy and procedure must be compiled and implemented. — A detailed construction risk assessment must be undertaken prior to construction work. — The necessary Personal Protective Equipment (PPE) must be provided and worn at the required working areas. — Ensure that relevant SHE appointees are in place. — Contractor's safety files must be in place and kept up to date. — All necessary health controls/ practices must be in place, e.g. ventilation of welding and painting areas. — SHE monitoring and reporting programs must be in place and implemented.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Chronic exposure to toxic chemical or biological agents									
	— An emergency response plan must be compiled prior to construction, which must include aspects such as appointment of emergency controller, provision of first aid, first responder contact numbers.								

HUMAN HEALTH - EXPOSURE TO NOISE

Exposure to drilling, piling, generators, air compressors during construction could lead to an adverse impact on hearing of workers as well as a possible nuisance factor in near-by areas. The construction impact associated with exposure to noise is outlined in **Table 7-58.**

Table 7-58: Construction Impact on human health - exposure to noise

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	3	1	5	5	4	**56**	**Moderate**	(-)	Easy
With Mitigation	2	1	5	5	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— A health risk assessment must be undertaken to determine if equipment continuous noise exceeds 85dB at workstation and 61dB at the boundary of the site. — Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.								

HUMAN HEALTH - EXPOSURE TO TEMPERATURE EXTREMES AND/OR HUMIDITY

During construction workers will be exposed to heat during the day and cold in winter. This could result in heat stroke or Hypothermia. The construction impact associated with exposure to temperature extremes and/or humidity is outlined in in **Table 7-59.**

Table 7-59: Construction Impact on human health - exposure to temperature extremes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	3	2	3	1	2	**18**	**Low**	(-)	Easy
With Mitigation	2	2	3	1	1	**8**	**Very low**	(-)	
Mitigation and Management Measures	— Construction site facilities to comply with Occupational Health and Safety Act 85 of 1993, specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. — Adequate potable water to be provided for employees during all phases of the project. Bore hole, bowser and tank or small water treatment plant may be required to provide potable water for the BESS installation staff during all phases of the project.								

HUMAN HEALTH - CHRONIC EXPOSURE TO PSYCHOLOGICAL STRESS

The construction of large projects brings many contractor workers into a small, isolated community. This may lead to a lack of sufficient accommodation, entertainment etc, resulting in an increase in alcohol abuse and violence. The construction impact associated with psychological stress is outlined in **Table 7-60**.

Table 7-60: Construction Impact on human health – exposure to psychological stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	2	3	3	2	2	**20**	**Low**	(-)	Easy
With Mitigation	2	3	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Refer to Social Impact Assessment for this project (**Section 8.16**).								

HUMAN HEALTH - CHRONIC EXPOSURE TO ERGONOMIC STRESS

Lifting of heavy equipment and movement at awkward angles during construction may result in back and other injuries. The construction impact associated with ergonomic stress is outlined in **Table 7-61.**

Table 7-61: Construction impact on human health – exposure to ergonomic stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	4	1	3	2	3	**30**	**Low**	(-)	Moderate
With Mitigation	4	1	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Training in lifting techniques must be provided. — Ensure that despite the isolated location, all the necessary equipment is available (and well maintained) during construction. Otherwise, employees may revert to unsafe practices. The necessary equipment must be available prior to the commencement of the project. — Isolated location, maintenance of construction equipment to ensure safe operation is critical. Ensure this is in place prior to project beginning. — Consider supporting the development of local service providers when sourcing and maintaining equipment. — First aid provision on site.								

HUMAN AND EQUIPMENT SAFETY – EXPOSURE TO FIRE RADIATION

The construction phase could result in activities that pose a fire risk. This includes fire involving fuels used in construction vehicles or vehicles themselves (e.g. tyre fire), fire due to uncontrolled welding or other hot-work. This will result in injuries due to radiation especially amongst first responders and bystanders. Fatalities are unlikely from the heat radiation as not highly flammable nor massive fire. The construction impact associated with exposure to fire radiation is outlined in **Table 7-62.**

Table 7-62: Construction impact on human and equipment safety – exposure to fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	4	2	3	5	4	**56**	**Moderate**	(-)	Complex
With Mitigation	4	2	3	5	2	**28**	**Low**	(-)	
Mitigation and Management Measures	— Fuels stored on site must be situated in dedicated, demarcated and bunded areas. — Suitable fire-fighting equipment must be available on site near source of fuel, e.g. diesel tank, generators, mess, living quarters, workshops etc — The company responsible for the facility at this stage is to have:								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
	— An emergency plan must be in place prior to commencement of construction. — Fuel spill containment procedures and equipment must be provided for and in place. — Hot-work permit and management system must be in place.								

Solid state battery containers damaged on route e.g. dropped in port (drops do happen about 1/2000 containers) and importing of possibly approximately 100 containers for the site. With this it is possible, although unlikely, that one will be dropped, or a traffic accident may occur on-route. This includes involvement in an external fire e.g. at the port or on route. Data indicates installed facility events are 0.001/year. Transport of 100 units per installation is assumed to take 4 weeks each so f= 0.008 once in 125 years, so the likelihood is very low. A consequence of this could be injuries due to radiation especially amongst first responders and bystanders. Fatalities are unlikely from the heat radiation as it is not highly flammable nor massive. The construction impact on human and equipment safety - exposure to fire radiation is outlined in **Table 7-63**.

Table 7-63: Construction Impact on human and equipment safety - exposure to fire radiation for SSL BESS

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	5	2	5	5	2	**34**	**Moderate**	(-)	Complex
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	

Mitigation and Management Measures	— Solid state battery design must include abuse tests such as drop test, impact, rapid discharge etc. Propagation tests for systems, e.g. heat insulating materials between cells/modules must be conducted. Factory acceptance test prior to leaving manufacture must be conducted. Batteries are usually stored at 50% charge to prolong life but may be shipped fully discharged. This level of detail should be understood so as to assess the risk during transport and storage.
	— The appointed contractor should ensure suitably competent transport companies are appointed. The company responsible for transportation should ensure:
	  — Compliance with National Road Traffic Act Regulation 8 – dangerous goods.
	  — Port Authorities should be alerted to the overall project and the hazardous nature of the contents of battery containers being imported. Note. If, as per one of the typical suppliers (Tesla) indications, the containers are classified as IMDG Class 9 – the containers will not receive any special care in the ports and may be stored next to flammables. Port emergency response in particular need training on mitigating battery hazards.
	— Prior to bringing any containers into the country a full Emergency response plan should be in place for the full route from the ship to the site. Drivers must be trained in the hazards of containerized batteries. The emergency plan to determine and address:
	  — What gases would be released in a fire and are there inhalation hazards.
	  — Extinguishing has two important elements, put out fire and to provide cooling. Different approaches may be needed for small fire – e.g. put out, and for large fires e.g. cool with								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
	copious quantities of water. Note inert gases and foam may put out the initial fire but fail to control thermal runaway or to cool the batteries resulting in reignition. — What initial fire extinguishing medium should be used? — Are there any secondary gases or residues from use of extinguishers? — If water is appropriate, may need outside connections to inside sprinklers. — First responders need to know what media to use, especially if water totally unsuitable and if there are no connection points for water etc. — PPE to be specified including possible exposure to chemicals and fumes as well as radiate heat. — Containment of residues/water/damaged equipment. — Compile and implement a disposal plan that manages the handling of partially and/or fully charged damaged units, contaminated surfaces (e.g. HF residues) and other associated dangerously charged components.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO EXPLOSION OVER PRESSURES

With solid state lithium containers, flammable gases generated by thermal run away reach explosive limits. The consequence of this is potential fatalities amongst first responders; damage to container, transport truck or other nearby items, e.g. other containers in the port. The construction impact on human and equipment safety - exposure to explosion over pressures is outlined in **Table 7-64**.

Table 7-64: Construction Impact on human and equipment safety - exposure to explosion over pressures

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures									
Without Mitigation	5	4	5	5	3	**57**	**Moderate**	(-)	N/A
With Mitigation	5	4	5	5	1	**19**	**Low**	(-)	
Mitigation and Management Measures	— Develop and implement an emergency response plan that deals with all emergency responses applicable to the BESS, including during transportation. — For simplicity one transport route would be preferable. The route needs to be assessed in terms of responding local services, rest places for drivers, refuelling if required, break down services available etc. — Once an import route has been chosen, e.g. Richards Bay or Durban and along N2/N3/N11 etc, then the appointed transport company should ensure key emergency services on route could be given awareness training in battery fire/accident response. — Emergency response planning and training referred to above may be important for key locations such as the mountain passes / tunnels.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ACUTE TOXIC CHEMICAL AND BIOLOGICAL AGENTS

Human pathogens and diseases, sewage, food waste as well as snakes, insects, wild and domesticated animals and harmful plants can cause illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc. The construction impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in **Table 7-65.**

Table 7-65: Construction Impact on human and equipment safety - exposure to acute toxic chemical and biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	2	3	2	3	33	Moderate	(-)	Complex
With Mitigation	3	2	3	2	2	20	Low	(-)	
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Policies and practice for dealing with known vectors of disease such as Aids, TB, COVID 19 and others must be developed and implemented. — Conduct awareness training for persons on site, safety induction to include animal hazards. — First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. — Due to isolated locations and distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts.								

Damaged solid-state batteries release fumes, leak electrolyte, are completely broken exposing hazardous chemicals and thermal runaway and hazardous fumes released can cause mild skin irritation from exposure to small leaks to serious corrosive burns or lung damage. The construction impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in **Table 7-66**.

Table 7-66: Construction Impact on human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	3	3	5	3	45	Moderate	(-)	Complex
With Mitigation	4	3	3	5	2	30	Low	(-)	
Mitigation and Management Measures	— Appointed transport company to ensure transport in accordance with Regulation 8 of the National Road Traffic Act 93 of 1996, Dangerous Goods. The transportation of prescribed goods in manner that is not consistent with the prescriptions, e.g. consignor and consignee responsibilities is not permitted. Prescription are found in SANS 10228/29 and international codes for battery transport etc. — SSL BESS must be transported in sealed packages that are kept upright, protected from movement damage etc. — These must be packaged to ensure no short-circuiting during transport. — Consideration must be taken to prevent excessive vibration as battery internal may be damaged leading to thermal run-away during commissioning. — Pre-assembled containers will most likely be supplied. These will be fitted with the necessary protective measures by the supplier considering marine and road transport as well as lifting, setting down etc.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
	— Route selection to consider possible incidents along the way and suitable response, e.g. satellite tracking, mobile communication, 24/7 helpline response. — Standard dangerous goods requirements for Hazmat labels must be adhered to, Transport Emergency Card (Trem cards) must be carried/held, and the driver/s must be trained on the hazards of the load.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO VIOLENT RELEASE OF KINETIC OR POTENTIAL ENERGY

Exposure to construction moving equipment, heavy loads, elevated loads, and working at heights can cause injury or possibly fatality, as well as damage to equipment, delays in starting the project and financial losses. The construction impact on human and equipment safety **-** exposure to violent release of kinetic or potential energy is outlined in **Table 7-67**.

Table 7-67: Construction Impact on human and equipment safety - exposure to violent release of kinetic or potential energy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
Without Mitigation	5	1	5	5	4	64	High	(-)	Complex
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— The construction phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. — A SHEQ policy must be compiled and implemented. — Develop a detailed construction risk assessment prior to construction work. — A SHE procedure must be developed and implemented. — The necessary PPE to be worn must specified. — Ensure that relevant SHE appointees are in place. — Contractor's safety files must be in place and kept up to date. — SHE monitoring and reporting programs must be developed and implemented. — Standard construction site rules regarding traffic, reversing sirens, rigging controls, cordoning off excavations etc must be developed and adhered to. — Civil works and building structures must adhere to the National Building Regulations and building Standards Act 103 of 1977 SANS 10400 and other relevant codes. — Other constructions such as roads, sewers etc must also adhere to relevant SANS standards. — All normal procedures for working at heights, hot work permits, confined space entry, cordon off excavations etc must be developed before construction begins. — An emergency response plan must be compiled before construction begins.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ELECTROMAGNETIC WAVES

Construction activities will include the use of electrical machines, generators etc. Hot dry area static generation is highly likely as well as lightning strikes. This may cause electrocution, ignition, burns, injury and death, as well as damage to electrical equipment. The construction impact on exposure to electromagnetic waves is outlined in **Table 7-68.**

Table 7-68: Construction Impact on human and equipment safety - exposure to electromagnetic waves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
Without Mitigation	5	2	5	5	3	51	Moderate	(-)	Complex
With Mitigation	5	2	5	5	1	17	Low	(-)	
Mitigation and Management Measures	— Implement standard maintenance of condition of electrical equipment and adhere to safe operating instructions. — Consideration should be given, where required, for remote isolation devices or switching measures on equipment, plant and machinery to ensure the ability to shut off power to systems in use on site. — If persons are decanting fuels or dealing with other highly flammable materials care should be taken regarding possible static discharge, installations to be suitably designed and maintained. — Lightning strike rate in the study area is very high. Outside work must be stopped during thunderstorms. — Lighting conductors may be required for the final installation, to be confirmed during design phase.								

ENVIRONMENT - EMISSIONS TO AIR

Dust from construction and generally hot dry area may cause adverse impact on employee health. The construction impact of emissions to air is indicated in **Table 7-69**.

Table 7-69: Construction Impact on the environment - emissions to air

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
Without Mitigation	3	2	1	1	4	28	Low	(-)	Easy
With Mitigation	2	2	1	1	2	12	Very Low	(-)	
Mitigation and Management Measures	— Implement dust control measures such as dampening of roads etc., particularly during dry or windy weather conditions, as per normal construction practices. — Construction workers to make use of necessary PPE (dust masks) when required.								

ENVIRONMENT - EMISSIONS TO WATER

The construction phase will make use of diesel for equipment, paints and solvents. There is also a possibility of Transformer oil spills and Sewage and kitchen/mess area wastewater generation. This could lead to environmental damage, particularly to the surface and underground water in the area if not managed correctly. The construction impact on environment due to emissions to water is outlined in **Table 7-70**.

Table 7-70: Construction impact on the environment - emissions to water

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
Without Mitigation	2	2	3	2	3	**27**	**Low**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Normal construction site practices for preventing and containing fuels/paint/oil etc spills must be adhered to. — Appropriate bunding under any temporary tanks, curbing under truck offloading areas and sealed surfaces (e.g. concrete) under truck parking area is particularly important and must be provided for. — Spill clean-up procedures to be in place before commencing construction. — Sewage and any kitchen liquids must have containment and suitable treatment/disposal must be followed.								

ENVIRONMENT - EMISSIONS TO EARTH

The construction phase will generate solid waste. Improper management of this waste will result in environmental pollution. The construction impact on waste generation is outlined in **Table 7-71.**

Table 7-71: Construction impact on the environment - emissions to earth

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to earth									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Easy
With Mitigation	1	2	3	3	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Solid waste, including packaging materials, must be collected and stored within designated areas on site and thereafter removed for disposal at a licensed waste disposal facility on a regular basis, as well as after regular maintenance. — Implement system for waste segregation (e.g. electronic equipment, chemicals) and management on the site.								

ENVIRONMENT – WASTE OF RESOURCES

The construction phase will require the usage of water and power, however if the usage is not controlled it will result in wastages. Furthermore, battery containers may be damaged during handling and/or transportation and may lead to construction delays. The construction impact of waste of resources e.g. water, power etc., is outlined in **Table 7-72.**

Table 7-72: Construction impact on the environment – waste of resources

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	1	1	1	2	4	**20**	**Low**	(-)	Easy
With Mitigation	1	1	1	2	2	**10**	**Very low**	(-)	
Mitigation and Management Measures	— Water usage to be monitored on site during construction. — Handling protocols must be provided by the battery supplier. — End of Life plan needs to be in place before any battery containers enter the country as there may be damaged battery unit from day 1.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
	— Develop and implement a water management plan and spill containment plan.								

PUBLIC - AESTHETHICS

The construction site will likely have bright surfaces reflecting light and tall structures in a flat area. This is likely to cause irritation/annoyance to the public. The construction impact on public aesthetics is outlined in **Table 7-73.**

Table 7-73: Construction impact on public - aesthetics

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	2	2	3	3	3	30	Low	(-)	Moderate
With Mitigation	1	2	3	4	2	20	Low	(-)	
Mitigation and Management Measures	— Refer to visual impact assessment (**Section 8.12**).								

INVESTORS - FINANCIAL

The result of possible defective technology and extreme project delays could result in financial loss for investors. The construction impact on investors – financial is outlined in **Table 7-74.**

Table 7-74: Construction impact on Investors - Financial

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - Financial									
Without Mitigation	5	1	3	4	3	39	Moderate	(-)	Moderate
With Mitigation	3	1	3	4	2	22	Low	(-)	
Mitigation and Management Measures	— Undertake adequate research during the planning and design phase to select the supplier and/contractor with the best technology that is internationally recognized and proven. — Project management to include deviation monitoring systems.								

EMPLOYEES AND INVESTORS – SECURITY

During the construction phase there is a potential for hi-jacking of valuable but hazardous load while en-route to site. Theft of construction equipment and battery installation facilities is also a possibility on site. Civil unrest or violent strike by employees can also arise. The construction impact of security is outlined in **Table 7-75.**

Table 7-75: Construction impact on employees and investors - security

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	4	1	3	2	4	40	Moderate	(-)	Complex
With Mitigation	4	1	3	2	4	27	Low	(-)	
Mitigation and Management Measures	— Fencing around the electrical infrastructure to adhere to SANS standard and Eskom Guidelines. — The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g. Skull and Cross Bones or other signs.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
	— Night lighting to be provided both indoors and outdoors where necessary.								

EMERGENCIES

During the construction phase, there is the potential for fires, explosions, noxious smoke, large spills, traffic accidents and equipment/structural collapse. Inadequate emergency response to small event can lead to escalation. Consequences of these include injuries which can turn to fatalities, and small losses become extended down time. The construction impact of emergencies is outlined in **Table 7-76.**

Table 7-76: Construction impact on emergencies

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Emergencies									
Without Mitigation	4	2	3	5	4	56	Moderate	(-)	Complex
With Mitigation	4	2	3	5	2	28	Low	(-)	
Mitigation and Management Measures	— All safety measures listed in **Table 7-75** must be implemented. — Emergency procedures need to be practiced prior to commencement of construction. — BESS units should not be stored any closer to each other than they would be in the final installation so that propagation is prevented, i.e. laydown area needs to be considered. — The company in charge of the containers at each stage in the transport process needs to be very clear so that responsibility for the integrity of the load and protection of the persons involved in transfer and coordination of emergency response on-route. E.g. if purchased from Tesla where does hand over occur to the South African contractor / owner, at the factory door in USA, at the port in RSA, at the site fence. For example, who will be accountable if there's thermal runway event on a truck with a container that stops in a small town for driver refreshments.									

INVESTORS LEGAL

The battery industry is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. This could result in unknown hazards manifest due to using "cheaper supplier or less developed technology". The construction impact of battery technology on investors is outlined in **Table 7-77.**

Table 7-77: Construction impact on investors - legal

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Without Mitigation	3	1	3	3	4	40	Moderate	(-)	Moderate
With Mitigation	2	1	3	3	2	18	Low	(-)	
Mitigation and Management Measures	— Use only internationally reputable technology suppliers who comply with all known regulations/guideline at the time of purchasing. — Ensure only latest state of the art technology systems are used and not old technologies prone to fires/explosions etc..								

VANADIUM REDOX FLOW BATTERY ENERGY STORAGE SYSTEMS

HUMAN HEALTH - CHRONIC EXPOSURE TO TOXIC CHEMICAL OR BIOLOGICAL AGENTS

Exposure to materials such as cement, paints, solvents, welding fumes, truck fumes etc. during construction can result in employee / contractor illness. The construction impact associated with chronic exposure to toxic chemical or biological agents is outlined in **Table 7-78**.

Table 7-78: Construction Impact on human health – exposure to toxic chemical or biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human health - Chronic exposure to toxic chemical or biological agents									
Without Mitigation	3	1	3	4	4	**44**	**Moderate**	(-)	Moderate
With Mitigation	1	1	3	4	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— The construction phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. — A SHEQ policy and procedure must be compiled and implemented. — A detailed construction risk assessment must be undertaken prior to construction work. — The necessary Personal Protective Equipment (PPE) must be provided and worn at the required working areas. — Ensure that relevant SHE appointees are in place. — Contractor's safety files must be in place and kept up to date. — All necessary health controls/ practices must be in place, e.g. ventilation of welding and painting areas. — SHE monitoring and reporting programs must be in place and implemented. — An emergency response plan must be compiled prior to construction, which must include aspects such as appointment of emergency controller, provision of first aid, first responder contact numbers.								

HUMAN HEALTH - EXPOSURE TO NOISE

Exposure to drilling, piling, generators, air compressors during construction could lead to an adverse impact on hearing of workers as well as a possible nuisance factor in near-by areas. The construction impact associated with exposure to noise is outlined in **Table 7-79.**

Table 7-79: Construction Impact on human health - exposure to noise

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	3	1	5	5	4	**56**	**Moderate**	(-)	Easy
With Mitigation	2	1	5	5	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— A health risk assessment must be undertaken to determine if equipment continuous noise exceeds 85dB at workstation and 61dB at the boundary of the site. — Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.								

HUMAN HEALTH - EXPOSURE TO TEMPERATURE EXTREMES AND/OR HUMIDITY

During construction workers will be exposed to heat during the day and cold in winter. This could result in Heat stroke or Hypothermia. The construction impact associated with exposure to temperature extremes and/or humidity is outlined in in **Table 7-80.**

Table 7-80: Construction Impact on human health - exposure to temperature extremes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	3	2	3	1	2	18	Low	(-)	Easy
With Mitigation	2	2	3	1	1	8	Very low	(-)	
Mitigation and Management Measures	— Construction site facilities to comply with Occupational Health and Safety Act 85 of 1993, specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. — Adequate potable water to be provided for employees during all phases of the project. Bore hole, bowser and tank or small water treatment plant may be required to provide potable water for the BESS installation staff during all phases of the project.								

HUMAN HEALTH - CHRONIC EXPOSURE TO PSYCHOLOGICAL STRESS

The construction of large projects brings many contractor workers into a small, isolated community. This may lead to a lack of sufficient accommodation, entertainment etc, resulting in an increase in alcohol abuse and violence. The construction impact associated with psychological stress is outlined in **Table 7-81**.

Table 7-81: Construction Impact on human health – exposure to psychological stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	2	3	3	2	2	20	Low	(-)	Easy
With Mitigation	2	3	3	2	2	20	Low	(-)	
Mitigation and Management Measures	— Refer to Social Impact Assessment for this project (**Section 8.16**).								

HUMAN HEALTH - CHRONIC EXPOSURE TO ERGONOMIC STRESS

Lifting of heavy equipment and movement into awkward angles during construction may result in back and other injuries. The construction impact associated with ergonomic stress is outlined in **Table 7-82.**

Table 7-82: Construction impact on human health – exposure to ergonomic stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	4	1	3	2	3	30	Low	(-)	Moderate
With Mitigation	4	1	3	2	2	20	Low	(-)	
Mitigation and Management Measures	— Training in lifting techniques must be provided. — Ensure that despite the isolated location, all the necessary equipment is available (and well maintained) during construction. Otherwise, employees may revert to unsafe practices. — Isolated location, maintenance of construction equipment to ensure safe operation is critical. Ensure this is in place prior to project beginning. — Ensure First aid provision on site.								

HUMAN AND EQUIPMENT SAFETY – EXPOSURE TO FIRE RADIATION

The construction phase could result in activities that pose a fire risk. This includes fire involving fuels used in construction vehicles or vehicles themselves (e.g. tyre fire), fire due to uncontrolled welding or other hot-work.

This will result in injuries due to radiation especially amongst first responders and bystanders. Fatalities are unlikely from the heat radiation as not highly flammable nor massive fire. The construction impact associated with exposure to fire radiation is outlined in **Table 7-83.**

Table 7-83: Construction impact on human and equipment safety – exposure to fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	4	2	3	5	4	56	Moderate	(-)	Complex
With Mitigation	4	2	3	5	2	28	Low	(-)	
Mitigation and Management Measures	— Fuels stored on site must be situated in dedicated, demarcated and bunded areas. — Suitable fire-fighting equipment must be available on site near source of fuel, e.g. diesel tank, generators, mess, living quarters, workshops etc — The company responsible for the facility at this stage is to have: — An emergency plan must be in place prior to commencement of construction. — Fuel spill containment procedures and equipment must be provided for and in place. — Hot-work permit and management system must be in place.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ACUTE TOXIC CHEMICAL AND BIOLOGICAL AGENTS

Human pathogens and diseases, sewage, food waste as well as snakes, insects, wild and domesticated animals and harmful plants can cause illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc. The construction impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in **Table 7-84.**

Table 7-84: Construction Impact on human and equipment safety - exposure to acute toxic chemical and biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	2	3	2	3	33	Moderate	(-)	Complex
With Mitigation	3	2	3	2	2	20	Low	(-)	
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Policies and practice for dealing with known vectors of disease such as Aids, TB, COVID 19 and others must be developed and implemented. — Conduct awareness training for persons on site, safety induction to include animal hazards. — First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. — Due to isolated locations and distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO VIOLENT RELEASE OF KINETIC OR POTENTIAL ENERGY

Exposure to construction moving equipment, heavy loads, elevated loads, and working at heights can cause injury or possibly fatality, as well as damage to equipment, delays in starting the project and financial losses. The construction impact on human and equipment safety - exposure to violent release of kinetic or potential energy is outlined in **Table 7-85**.

Table 7-85: Construction Impact on human and equipment safety - exposure to violent release of kinetic or potential energy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
Without Mitigation	5	1	5	5	4	64	High	(-)	Complex
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— The construction phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. — A SHEQ policy must be compiled and implemented. — Develop a detailed construction risk assessment prior to construction work. — A SHE procedure must be developed and implemented. — The necessary PPE to be worn must specified. — Ensure that relevant SHE appointees are in place. — Contractor's safety files must be in place and kept up to date. — SHE monitoring and reporting programs must be developed and implemented. — Standard construction site rules regarding traffic, reversing sirens, rigging controls, cordoning off excavations etc must be developed and adhered to. — Civil works and building structures must adhere to the National Building Regulations and building Standards Act 103 of 1977 SANS 10400 and other relevant codes. — Other constructions such as roads, sewers etc must also adhere to relevant SANS standards. — All normal procedures for working at heights, hot work permits, confined space entry, cordon off excavations etc must be developed before construction begins. — An emergency response plan must be compiled before construction begins.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ELECTROMAGNETIC WAVES

Construction activities will include the use of electrical machines, generators etc. Hot dry area static generation is highly likely as well as lightning strikes. This may cause electrocution, ignition, burns, injury and death, as well as damage to electrical equipment. The construction impact on exposure to electromagnetic waves is outlined in **Table 7-86.**

Table 7-86: Construction Impact on human and equipment safety - exposure to electromagnetic waves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
Without Mitigation	5	2	5	5	3	51	Moderate	(-)	Complex
With Mitigation	5	2	5	5	1	17	Low	(-)	
Mitigation and Management Measures	— Implement standard maintenance of condition of electrical equipment and adhere to safe operating instructions.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
	— Consideration should be given, where required, for remote isolation devices or switching measures on equipment, plant and machinery to ensure the ability to shut off power to systems in use on site. — If persons are decanting fuels or dealing with other highly flammable materials care should be taken regarding possible static discharge, installations to be suitably designed and maintained. — Lightning strike rate in the study area is very high. Outside work must be stopped during thunderstorms. — Lighting conductors may be required for the final installation, to be confirmed during design phase.								

ENVIRONMENT - EMISSIONS TO AIR

Dust from construction and generally hot dry area may cause adverse impact on employee health. The construction impact of emissions to air is indicated in **Table 7-87**.

Table 7-87: Construction Impact on the environment - emissions to air

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
Without Mitigation	3	2	1	1	4	**28**	**Low**	(-)	Easy
With Mitigation	2	2	1	1	2	**12**	**Very Low**	(-)	
Mitigation and Management Measures	— Implement dust control measures such as dampening of roads etc., particularly during dry or windy weather conditions, as per normal construction practices. — Construction workers to make use of necessary PPE (dust masks) when required.								

ENVIRONMENT - EMISSIONS TO WATER

The construction phase will make use of diesel for equipment, paints and solvents. There is also a possibility of Transformer oil spills and Sewage and kitchen/mess area wastewater generation. This could lead to environmental damage, particularly to the surface and underground water in the area if not managed correctly. The construction impact on environment due to emissions to water is outlined in **Table 7-88**.

Table 7-88: Construction impact on the environment - emissions to water

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
Without Mitigation	2	2	3	2	3	**27**	**Low**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Normal construction site practices for preventing and containing fuels/paint/oil etc spills must be adhered to. — Appropriate bunding under any temporary tanks, curbing under truck offloading areas and sealed surfaces (e.g. concrete) under truck parking area is particularly important and must be provided for. — Spill clean-up procedures to be in place before commencing construction.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
	— Sewage and any kitchen liquids must have containment and suitable treatment/disposal must be followed.								

ENVIRONMENT - EMISSIONS TO EARTH

The construction phase will generate solid waste. Improper management of this waste will result in environmental pollution. The construction impact on waste generation is outlined in **Table 7-89.**

Table 7-89: Construction impact on the environment - emissions to earth

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – waste generation									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Easy
With Mitigation	1	2	3	3	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Solid waste, including packaging materials, must be collected and stored within designated areas on site and thereafter removed for disposal at a licensed waste disposal facility on a regular basis, as well as after regular maintenance. — Implement system for waste segregation (e.g. electronic equipment, chemicals) and management on the site.								

ENVIRONMENT – WASTE OF RESOURCES

The construction phase will require the usage of water and power, however if the usage is not controlled it will result in wastages. Furthermore, battery containers may be damaged during handling and/or transportation and may lead to construction delays. The construction impact of waste of resources e.g. water, power etc., is outlined in **Table 7-90.**

Table 7-90: Construction impact on the environment – waste of resources

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	1	1	1	2	4	**20**	**Low**	(-)	Easy
With Mitigation	1	1	1	2	2	**10**	**Very low**	(-)	
Mitigation and Management Measures	— Water usage to be monitored on site during construction. — Handling protocols must be provided by the battery supplier. — Develop and implement a water management plan and spill containment plan.								

PUBLIC - AESTHETHICS

The construction site will likely have bright surfaces reflecting light and tall structures in a flat area. This is likely to cause irritation/annoyance to the public. The construction impact on public aesthetics is outlined in **Table 7-91.**

Table 7-91: Construction impact on public - aesthetics

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	3	2	3	4	4	48	Moderate	(-)	Moderate
With Mitigation	1	2	3	4	2	20	Low	(-)	
Mitigation and Management Measures	— Visual impact assessment to include BESS installation when design details become available. Confirm height limitations for VRFB BESS building (if utility scale).								

INVESTORS - FINANCIAL

The result of possible defective technology and extreme project delays could result in financial loss for investors. The construction impact on investors – financial is outlined in **Table 7-92.**

Table 7-92: Construction impact on Investors - Financial

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - Financial									
Without Mitigation	5	1	3	4	3	39	Moderate	(-)	Moderate
With Mitigation	3	1	3	4	2	22	Low	(-)	
Mitigation and Management Measures	— Undertake adequate research during the planning and design phase to select the supplier and/contractor with the best technology that is internationally recognized and proven. — Project management to include deviation monitoring systems.								

EMPLOYEES AND INVESTORS – SECURITY

During the construction phase there is a potential for hi-jacking of valuable but hazardous loads while en-route to site. Theft of construction equipment and battery installation facilities is also a possibility on site. Civil unrest or violent strike by employees can also arise. This may result in theft, injury to burglars, damage to equipment possibly setting off thermal runaway. The construction impact of security is outlined in **Table 7-93.**

Table 7-93: Construction impact on employees and investors - security

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	4	1	3	2	4	40	Moderate	(-)	Complex
With Mitigation	4	1	3	2	4	27	Low	(-)	
Mitigation and Management Measures	— Fencing around the electrical infrastructure to adhere to SANS standard and Eskom Guidelines. — The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g. Skull and Cross Bones or other signs. — Night lighting to be provided both indoors and outdoors where necessary.								

EMERGENCIES

During the construction phase, there is the potential for fires, explosions, noxious smoke, large spills, traffic accidents and equipment/structural collapse. Inadequate emergency response to small event can lead to escalation. Consequences of these include injuries which can turn to fatalities, and small losses become extended down time. The construction impact of emergencies is outlined in **Table 7-94.**

Table 7-94: Construction impact on emergencies

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Emergencies									
Without Mitigation	4	2	3	4	3	39	Moderate	(-)	Complex
With Mitigation	4	2	3	4	2	26	Low	(-)	
Mitigation and Management Measures	— All safety measures listed in **Table 7-93** must be implemented. — Emergency procedures need to be practiced prior to commencement of construction.								

INVESTORS - LEGAL

The Battery sector is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. This could result in unknown hazards manifest due to using "cheaper supplier or less developed technology". The construction impact of battery technology on investors is outlined in **Table 7-95.**

Table 7-95: Construction impact on investors - legal matters

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Without Mitigation	3	1	3	3	4	40	Moderate	(-)	Moderate
With Mitigation	2	1	3	3	2	18	Low	(-)	
Mitigation and Management Measures	— Use only internationally reputable technology suppliers who comply with all known regulations/guideline at the time of purchasing. — Ensure only latest state of the art technology systems are used and not old technologies prone to fires/explosions etc..								

7.13.2 OPERATIONAL PHASE (INCLUDING COMMISSIONING)

SOLID STATE LITHIUM-ION BATTERY ENERGY STORAGE SYSTEMS

From the details of accidents that have happened both with BESS installations and chemical plants in general, it is clear that many potential problems manifest during the commissioning phase when units are first powered up to test functionality. This phase is critical and all controls, procedures, mitigation measures etc that would be in place for full operation should be in place before commissioning commences.

HUMAN HEALTH - CHRONIC EXPOSURE TO TOXIC CHEMICAL OR BIOLOGICAL AGENTS

Operation and maintenance materials such as spare parts, paints, solvents, welding fumes, transformers oils, lubricating oils and greases etc., may cause occupational illness. The operational impact on human health **-** chronic exposure to toxic chemical or biological agents is outlined in **Table 7-96**.

Table 7-96: Operational Impact on human health - chronic exposure to toxic chemical or biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Chronic exposure to toxic chemical or biological agents									
Without Mitigation	2	1	3	4	5	50	Moderate	(-)	Easy
With Mitigation	1	1	3	4	2	18	Low	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Chronic exposure to toxic chemical or biological agents									

Mitigation and Management Measures	— The operation and maintenance phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993.
	— A SHEQ policy must be in place prior to commissioning.
	— A detailed risk assessment of all normal operating and maintenance activities on site to be compiled, and form the basis of operating instructions, prior to commencing commissioning.
	— A SHE procedure must be in place prior to commissioning, and must include, but not limited to, PPE requirements, management of change, integrity monitoring.
	— Ensure that relevant SHE appointees are in place.
	— Training of staff on general hazards on site must be conducted.
	— All necessary health controls/ practices to be in place, e.g. ventilation of confined areas, occupational health monitoring if required and reporting programs must be in place and implemented.
	— An emergency response plan for full operation and maintenance phase to be in place prior to beginning commissioning and to include aspects such as:
	  — appointment of emergency controller,
	  — emergency isolation systems for electricity,
	  — emergency isolation and containment systems for electrolyte,
	  — provision of PPE for hazardous materials response,
	  — provision of emergency facilities for staff at the main office building,
	  — provision of first aid facilities,
	  — first responder contact numbers etc.								

Compromised battery compartment vapours accumulate in the containers, as well as release solids/liquids on surfaces. Maintenance of battery components can cause corrosive and mildly toxic liquid on surfaces. This can result in dermatitis, and skin /eye/lung irritation. The operational impact on human health - chronic exposure to toxic chemical or biological agents is outlined in **Table 7-97**.

Table 7-97: Operational Impact on human health - chronic exposure to toxic chemical or biological agents for SSL BESS

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - Chronic exposure to toxic chemical or biological agents									
Without Mitigation	3	1	3	5	4	48	Moderate	(-)	Complex
With Mitigation	1	1	3	5	2	20	Low	(-)	
Mitigation and Management Measures	— Maintenance procedures must be in place should equipment need to be opened, e.g. pumps drained and decontaminated prior to repair in workshop etc. — Ensure PPE for handling battery parts and other equipment on site is specified and worn when required. — Training of staff on general hazards on site must be conducted.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - Chronic exposure to toxic chemical or biological agents									
	— Install a leak detection system with local alarms if regulated occupational exposure limits are exceeded etc prior to entry for inspection of battery containers. — Provide signage or labels on all equipment. — Confined space entry procedures must be developed and adhered to when entering tanks and possibly battery containers. — There needs to be careful thought given to procedures to be adopted before entering into the BESS or a container under normal circumstances (confined space) but particularly after a BMS shut down where there may be flammable or toxic gases present, a fire etc. Any situation could await those entering. — Safety Data Sheets (SDSs) must be available on site. — Operating manuals must be provided including start-up, shut-down, steady state, monitoring requirements. — Maintenance manuals with make safe, decontamination and repair procedures must also be in place. — A maintenance schedule must be developed and implemented to include the required daily, weekly, monthly, annual etc maintenance. — Provided portable equipment for calibration and for testing/verification of defective equipment, e.g. volt/current meters, infrared camera.								

HUMAN HEALTH - EXPOSURE TO NOISE

Moving parts inside containers, buildings, pumps, compressors, cooling systems etc., can cause adverse impact on hearing of workers, or may be a nuisance factor at near -by residences or other activities. The operational impact on human health - exposure to noise is outlined in **Table 7-98**.

Table 7-98: Operational Impact on human health - exposure to noise

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	2	1	5	5	4	52	Moderate	(-)	Easy
With Mitigation	2	1	5	5	2	26	Low	(-)	
Mitigation and Management Measures	— Design the system to ensure continuous noise does not exceed 85dB within the facilities or at any other location on site or 61 dB at the site boundary, e.g. emergency generator, air compressor etc. — Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.								

HUMAN HEALTH - EXPOSURE TO TEMPERATURE EXTREMES AND/OR HUMIDITY

Workers may be exposed to extreme temperatures and/or humidity such as heat during the day and cold weather in winter. Batteries can also generate heat within enclosed buildings / containers, and night work requires lighting which can generate heat. This could result in heat stroke or hypothermia. The operational impact on human health - exposure to temperature extremes and/or humidity is outlined in **Table 7-99**.

Table 7-99: Operational Impact on human health - exposure to temperature extremes and/or humidity

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	4	2	3	1	2	20	Low	(-)	Easy
With Mitigation	3	2	3	1	1	9	Very Low	(-)	
Mitigation and Management Measures	— Building and container facilities to comply with Occupational Health and Safety Act 85 of 1993 specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. — Ensure containers are temperature controlled as required to remain within the optimal battery operating temperature range. — Lighting to be provided inside any buildings, inside the containers, possibly linked to the door opening and outdoors where necessary. — Adequate potable water to be provided during all phases of the project. — Suitable lighting to be provided including emergency lighting for safe building exit in the event of power failure. — PPE for operations and maintenance staff to be suitable for the weather conditions.								

HUMAN HEALTH - EXPOSURE TO PSYCHOLOGICAL STRESS

Isolated workstation and monotonous repetitive work can cause low performance, and system productivity suffers. The operational impact on human health - exposure to psychological stress is outlined in **Table 7-100**.

Table 7-100: Operational Impact on human health - exposure to psychological stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	2	3	3	2	2	20	Low	(-)	Easy
With Mitigation	1	3	3	2	1	9	Very Low	(-)	
Mitigation and Management Measures	— Implement staff rotation to other activities within the site where necessary. — Performance monitoring of inspections / maintenance tasks in particular must be undertaken.								

HUMAN HEALTH - CHRONIC EXPOSURE TO ERGONOMIC STRESS

Lifting heavy equipment and movement at awkward angles during maintenance, stretching to reach high level and bending to low level, including working at heights if equipment is located on top of roofs or elevated electrical equipment (e.g. pylons), can result in back and other injuries. The operational impact on human health - exposure to ergonomic stress is outlined in **Table 7-101**.

Table 7-101: Operational Impact on human health - exposure to ergonomic stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	5	1	3	2	3	33	Moderate	(-)	Easy
With Mitigation	4	1	3	2	2	20	Low	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Human Health - exposure to ergonomic stress								
Mitigation and Management Measures	— Training in lifting techniques must be provided. — Working at heights training must be provided. — If equipment is at height, ensure suitable safe (electrically and physically) ladders / harnesses etc. are available. — A working at height procedure needs to be in place.							

HUMAN AND EQUIPMENT SAFETY – EXPOSURE TO FIRE RADIATION

During the operation of the facility there are chances of involvements in an external fire e.g. veld fire, maintenance vehicle fire, electrical systems fire. Manufacturing defects or damage to batteries leading to shorting and heating can also be an issue along with high humidity condensation of water or ingress of water or flooding leading to shorting. Dust accumulation on electrical parts leading to overheating. Excessive electrical loads and/or surges. Operator abuse, Battery management System (BMS) failure or software failure. Incorrect extinguishing mediums can escalate the fire. Consequences include contaminated run off. Radiation burns unlikely to be severe as no highly flammable materials on site. Damaged equipment. Fire spreads to other units or offsite if grass/vegetation not controlled. The operational impact on human and equipment safety **-** exposure to fire radiation is outlined in **Table 7-102**.

Table 7-102: Operational Impact on human and equipment safety - exposure to fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	5	1	5	5	3	48	Moderate	(-)	Complex
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— Grass cutting and fire breaks must be maintained around the BESS installations to prevent veld fires. No combustible materials to be stored in or near the batteries or electrical infrastructure. Ensure separation of site diesel tank, transformers from BESS and vice versa. — The Facility to comply with prescribed design standards such as the BESS design codes from the USA and standards of practice that (e.g. UL9540, NFPA 855 and DNV GL RP 43). — A detailed Failure Modes and Effects Analysis (FMEA) / (Hazard and Operability Analysis (HAZOP) / Bowtie methodology must be developed during design at the component level and system levels. — Conduct safety integrity level rating of equipment (failure probably) with suitable redundancy if required. — Conduct Site Acceptance Testing as part of commissioning of each unit and the overall system. — Abuse tests to be conducted by supplier. — Ensure an effective Battery Management System (BMS) is included in the design. BMS should be checking individual cell voltage as well as stack, module, container, system voltages/current etc. BMS tripping the cell and possibly the stack/ building unit or module/rack/container, if variations in voltage. — Diagnostics must be easily accessible. Diagnostics are able to distinguish cell from stack or cell from module faults. Protective systems are only as good as their reliability and functionality testing is important, e.g. testing that all battery trips actually work.									

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Human and Equipment Safety - exposure to fire radiation									
	— Fire resistant barrier between the batteries and the PCS side if in the same container, or separate containers must form part of the design. — Suitable ingress protection level to be provided for electrical equipment, e.g. IP55 - 66. If air cooling into container, suitable dust filters to be provided. — Install smoke detectors linked to BMS & alerts in control room. — Effects of battery aging to be considered. Solid state battery life starts to be impacted above 40 deg C and significant impacts above 50 deg C with thermal run away starting at 65-70 deg C. BMS trips system at 50 deg C. Temperature monitoring to be in place. Regular infrared scanning. Data needs to be stored for trend analysis. — An Emergency plan, from transport and construction phase, must be extended to operational phase. The plan must include the hazards of the electrically live system. This Plan must include procedures to address solid state container fires - extinguishing, ventilating, entering as appropriate or not. — PPE for container firefighting must include fire retardant, chemically resistant, nitrile gloves, antistatic acid resistant boots, fill face shields, BA sets. — A planned fire response to prevent escalation to an explosion or an environmental event must be developed. — Suitable supply of fire extinguishing medium and cooling medium must be provided. Consider fire water for cooling adjacent equipment for BESS units. Fogging nozzles can be used to direct smoke. — Ensure procedures in place for clean up after event Lingering HF and other toxic residues in the soil and on adjacent structures..								

A Power Conversion System's (PCS – DC to AC) cooling failure can result in electrical fire. The consequence of this is that a fire can start in PCS or another section or room and spread to the battery area. The operational impact on human and equipment safety - exposure to fire radiation is outlined in **Table 7-103**.

Table 7-103: Operational Impact on human and equipment safety - exposure to fire radiation for SSL BESS

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	5	2	5	5	3	51	Moderate	(-)	Moderate
With Mitigation	5	2	5	5	1	17	Low	(-)	
Mitigation and Management Measures	— Consider modern lithium container design - put the PCS in another part of the container with a fire rated wall separating it from the battery. Alternately the PCS is another container altogether.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO EXPLOSION OVER PRESSURES

Transformer shorting / overheating / explosion or flammable gases generated by thermal run away reach explosive limits. Ignition on hot surfaces can cause static. Lithium Cobalt Oxide generates O2 during decomposition which can cause escalation. This can result in potential fatalities amongst first responders, or damage to container or other nearby items, e.g. other container. The operational impact on human and equipment safety - exposure to explosion over pressures is outlined in **Table 7-104**.

Table 7-104: Operational Impact on human and equipment safety - exposure to explosion over pressures

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures[10]									
Without Mitigation	5	1	5	5	2	**32**	**Moderate**	(-)	Moderate
With Mitigation	5	1	5	5	1	**16**	**Low**	(-)	
Mitigation and Management Measures	— Electrical equipment will be specified to suit application. — An Emergency response plan must be in place as referred to above and employee training on the plan must be provided. — Undertake a hazardous area classification of the inside of the container to confirm the rating of electrical equipment. Might be zone 2 due to possible leaks of electrolyte or generation of flammable gases under thermal run away. — Suitable training of selected emergency responders who may be called out to the facility must be undertaken.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ACUTE TOXIC CHEMICAL AND BIOLOGICAL AGENTS

Human pathogens and diseases, sewage, food waste as well as snakes, insects, wild and domesticated animals and harmful plants can cause illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc. The operational impact on human and equipment safety **-** exposure to acute toxic chemical and biological agents is outlined in **Table 7-105**.

Table 7-105: Operational Impact on human and equipment safety - exposure to acute toxic chemical and biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	1	3	2	3	**30**	**Low**	(-)	Moderate
With Mitigation	3	1	2	2	2	**16**	**Low**	(-)	
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Policies and practice for dealing with known vectors of disease such as Aids, TB, COVID 19 and others must be developed and implemented. — Conduct awareness training for persons on site, safety induction to include animal hazards. — First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. — Due to isolated locations and distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts.								

Damaged battery components, leakage of electrolyte, or if the components are completely broken exposing hazardous chemicals, and thermal runaway and hazardous fumes are released, this can cause mild skin irritation

[10] Refer to Appendix A of the SHE Risk Assessment (**Appendix H-12**) for an initial approximation of worst-case possible explosion impact zones

from exposure to small leaks to serious corrosive burns for large exposure. The operational impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in **Table 7-106**.

Table 7-106: Operational Impact on human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents[11]									
Without Mitigation	4	3	3	5	3	**45**	**Moderate**	(-)	Moderate
With Mitigation	3	3	3	5	2	**28**	**Low**	(-)	
Mitigation and Management Measures	— Acid resistant PPE (e.g. overalls, gloves, eyeglasses) to be specified for all operations in electrolyte areas. — PPE to be increased (e.g. full-face shield, aprons, chemical suits) for operations that involve opening equipment and potential exposure, e.g. sampling, maintenance. — All operators/maintenance staff to be trained in the hazards of chemicals on site. — Refer to fire above as all the protective measures apply to prevent toxic smoke. — Refer to fire above as all the measures apply to mitigate toxic smoke. — Ensure a 24/7 helpline response. — Adhere to standard dangerous goods requirements for Hazmat labels. — All operators/maintenance staff to be trained in the hazards.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO VIOLENT RELEASE OF KINETIC OR POTENTIAL ENERGY

Moving equipment, pumps, heavy equipment at elevation, nip points, working at heights, traffic accidents and earthquake/tremors can cause injury or possibly fatality in unlikely worst case, damage to equipment, spills, and environment pollution. The operational impact on human and equipment safety - exposure to violent release of kinetic or potential energy is outlined in **Table 7-107**.

Table 7-107: Operational Impact on human and equipment safety - exposure to violent release of kinetic or potential energy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
Without Mitigation	5	1	5	5	3	**48**	**Moderate**	(-)	Moderate
With Mitigation	5	1	5	5	1	**16**	**Low**	(-)	
Mitigation and Management Measures	— Maintenance equipment to be serviced and personnel suitably trained in the use thereof. — Traffic signs, rules etc to be in place on site. — All normal working at heights, hot work permits, confined space entry, cordon off unsafe areas/works etc procedures to be in place. — An emergency response plan must be in place. — Civil design to take seismic activity into account.								

[11] Refer to Appendix A of the SHE Risk Assessment (Appendix H-12) for an initial approximation of worst-case possible noxious smoke impact zones

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ELECTROMAGNETIC WAVES

The operational phase will include the use of electrical machines, generators etc. In hot dry areas, static generation is highly likely, as well as lightning strike. This may cause electrocution, ignition, burns, injury and death, as well as damage to electrical equipment. The operational impact on human and equipment safety - exposure to electromagnetic waves is outlined in **Table 7-108.**

Table 7-108: Operational Impact on human and equipment safety - exposure to electromagnetic waves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
Without Mitigation	5	2	5	5	3	**51**	**Moderate**	(-)	Complex
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	
Mitigation and Management Measures	— Adhere to codes and guidelines for electrical insulation. — Provide suitable PPE. — Low voltage equipment (e.g. batteries) to be separated from high voltage (e.g. transmission to grid). — Personnel to be trained in line with IEE 1657 – 2018 (Recommended Practice for Personnel Qualifications for Installation and Maintenance of Stationary Batteries). — Adhere to Eskom Operating Regulations for high voltage systems including access control, permit to work, safe work procedures, live work, abnormal and emergency situations, keeping records. — Software also need to be kept as update to date as reasonably practicable. — Consider suitably located Emergency stop buttons for the facility and the other equipment on site. — PPE to consider static accumulation for entering the facility, and particularly the battery containers especially after a high temperature shut down where there could possibly be flammable materials. — The procedures for responding to alarm and auto shut down on containers, needs to consider that there may be a dangerous environment inside and how to protect personnel who may enter to respond. — All outside work must be stopped during thunder storms. — Lighting conductors may be required for the installation, to be confirmed during design									

ENVIRONMENT - EMISSIONS TO AIR

Refrigerant may be an asphyxiant if accidentally released indoors it can accumulate and displace oxygen. It is however noted that this is not expected on a normal basis. The operational impact on environment - emissions to air is outlined in **Table 7-109**.

Table 7-109: Operational Impact on environment - emissions to air

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
Without Mitigation	3	1	1	1	3	**18**	**Low**	(-)	Easy
With Mitigation	3	1	1	1	1	**6**	**Very Low**	(-)	
Mitigation and Management Measures	— Containers could be treated as entering a confined space and similar procedures entering confined spaces could be in place,								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
	e.g. do not enter alone, gas testing prior to entering, ensure adequate ventilation. Particularly after any warning alarms have gone off, but possibly even normally.								

ENVIRONMENT - EMISSIONS TO WATER

Waste will be generated during the operation of the facility. This may include cooling water blow-down, laboratory waste (if included in the design), maintenance waste, e.g. oils, spills from batteries, coolant system, diesel trucks, transformers, oil drips from parked vehicles, fire water runoff control, kitchen waste and sewage, refrigerant release. These can cause pollution if not contained and excessive disposal costs if emissions are not limited. The operational impact on environment - emissions to water is outlined in **Table 7-110**.

Table 7-110: Operational Impact on environment - emissions to water

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
Without Mitigation	2	2	3	2	3	**27**	**Low**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Implement bunding under any outdoors tanks, curbing under truck offloading areas and sealed surfaces (e.g. concrete) under truck parking area. — Provide containment and suitable treatment/disposal for sewage and any kitchen liquids. — Procedures for dealing with damaged/leaking equipment as well as clean-up of spills to be in place and implemented. — Conduct normal site practices for preventing and containing diesel/paint etc spills. — Waste management plan to be in place and provide measures for, but not limited to, liquid waste treatment or suitable removal and disposal. — Spill clean-up procedures to be in place before bringing container on site, including spill kits – non-combustible materials, hazmat disposal. — Undertake reporting of reportable quantities in line with NEMA.								

ENVIRONMENT - EMISSIONS TO EARTH

The operation phase will generate solid waste. The disposal of solid-state batteries can cause environmental damage. The operational impact on environment - emissions to earth is outlined in **Table 7-111**.

Table 7-111: Operational Impact on environment - emissions to earth

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – waste generation									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Easy
With Mitigation	2	2	3	3	1	**10**	**Very Low**	(-)	
Mitigation and Management Measures	— Implement system for waste segregation (e.g. electronic equipment, chemicals) and management on the site.								

ENVIRONMENT – WASTE OF RESOURCES

The operation phase will require the usage of water and power, however if the usage is not controlled it will result in wastages. Operations will include the disposal of batteries or components, or disposal of containers. This may result in delays, excessive costs and disposal of large volumes of hazardous waste. The operational impact on environment - waste of resources e.g. water, power etc is outlined in **Table 7-112**.

Table 7-112: Operational Impact on environment - waste of resources e.g. water, power

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	1	1	1	2	4	**20**	**Low**	(-)	Easy
With Mitigation	1	1	1	2	2	**10**	**Very Low**	(-)	
Mitigation and Management Measures	— Water usage to be monitored on site during construction. — Handling protocols must be provided by the battery supplier. — Develop and implement a water management plan and spill containment plan. — Investigate end of Life plan for solid state batteries including options for reuse / recovery / reconditioning. — Similarly, for decommissioned containers consider reuse / recovery / repurpose.								

PUBLIC - AESTHETHICS

Bright surfaces reflecting light and tall structures in a flat area may cause irritation. The operational impact on public - aesthetics is outlined in **Table 7-113**.

Table 7-113: Operational Impact on public

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	3	2	3	4	4	**48**	**Moderate**	(-)	Easy
With Mitigation	1	2	4	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Refer to Visual Impact Assessment which is to include the BESS installation once design details are available.								

INVESTORS - FINANCIAL

The result of possible defective technology and extreme project delays can cause financial loss. The operational impact on investors - financial is outlined in **Table 7-114**.

Table 7-114: Operational Impact on investors – financial

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - Financial									
Without Mitigation	5	1	3	4	3	**39**	**Moderate**	(-)	Easy
With Mitigation	3	1	3	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Undertake adequate research during the planning and design phase to select the supplier and/contractor with the best technology that is internationally recognized and proven. — Project management with deviation monitoring.								

EMPLOYEES AND INVESTORS – SECURITY

On route to the operational site there is a risk of potential hi-jacking of valuable but hazardous loads. On site there is a risk of theft of operational equipment and battery installation facilities. There may also be civil unrest or violent strike by employees. This may result in theft, injury to burglars, damage to equipment possibly setting off thermal runaway. The operational impact on employees and investors – security is outlined in **Table 7-115**.

Table 7-115: Operational Impact on employees and investors – security

Potential Impact Employees and investors - Security	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	1	3	2	4	36	Moderate	(-)	Moderate
With Mitigation	3	1	3	2	2	18	Low	(-)	
Mitigation and Management Measures	— Fencing around electrical infrastructure to adhere to SANS standard and Eskom Guidelines. — Consider motion detection lights and CCTV. — The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g. Skull and Cross Bones or other signs. — Night lighting to be provided both indoors and outdoors where necessary.								

Cyber security attacks aimed at the National Electricity Grid may result in the ransom of the National Electricity Grid. The operational impact on employees and investors – security is indicated in **Table 7-116**.

Table 7-116: Operational Impact on employees and investors – security

Potential Impact Employees and investors - Security	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	4	4	3	1	4	48	Moderate	(-)	Complex
With Mitigation	4	4	3	1	2	24	Low	(-)	
Mitigation and Management Measures	— Cyber security needs monitoring. — Remote access to system needs to be negotiated and controlled. — Install password controls, levels of authority etc. Protection of the National Electricity Grid from Cyber-attacks accessing through the BESS to be implemented. — Cyber emergency procedures should be in place prior to commissioning.								

EMERGENCIES

During the operational phase, there is the potential for fires, explosions, noxious smoke, large spills, traffic accidents and equipment/structural collapse. Inadequate emergency response to small event can lead to escalation. Consequences of these include injuries which can turn to fatalities, and small losses become extended down time. The operational impact on emergencies is outlined in **Table 7-117**.

Table 7-117: Operational Impact on emergencies

Potential Impact Emergencies	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	4	2	3	4	3	39	Moderate	(-)	Complex
With Mitigation	4	2	3	4	2	26	Low	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Emergencies									
Mitigation and Management Measures	— All safety measures listed above must be implemented. — Emergency procedures need to be practiced prior to commencement of operations. — Ensure escape door open outwards, and doors hooked open when persons are inside, i.e. they should not be automatically self-closing. — There must be more than one exit from buildings. — Storage of spare batteries (e.g. in stores on site or elsewhere) also needs to consider possible thermal run away.								

INVESTORS LEGAL

The battery industry is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. This may result in unknown hazards that may manifest due to using "cheaper supplier or less developed technology". The operational impact on investors – legal is indicated in **Table 7-118**.

Table 7-118: Operational Impact on investors – legal

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Without Mitigation	3	1	3	3	4	40	Moderate	(-)	Moderate
With Mitigation	3	1	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— Use only internationally reputable battery suppliers who comply with all known regulations/guideline at the time of purchasing. — Ensure only latest state of the art battery system are used and not old technologies prone to fires/explosions etc..								

VANADIUM REDOX FLOW BATTERY ENERGY STORAGE SYSTEMS

From the details of accidents that have happened both with BESS installations and chemical plants in general, it is clear that many potential problems manifest during the commissioning phase when units are first powered up to test functionality. This phase is critical and all controls, procedures, mitigation measures etc that would be in place for full operation should be in place before commissioning commences.

HUMAN HEALTH - CHRONIC EXPOSURE TO TOXIC CHEMICAL OR BIOLOGICAL AGENTS

Operation and maintenance materials such as spare parts, paints, solvents, welding fumes, transformers oils, lubricating oils and greases etc., can result in occupational illness. The operational impact on human health - chronic exposure to toxic chemical or biological agents is indicated in **Table 7-119**.

Table 7-119: Operational Impact on human health - chronic exposure to toxic chemical or biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human health - Chronic exposure to toxic chemical or biological agents									
Without Mitigation	2	1	3	4	5	50	Moderate	(-)	Easy
With Mitigation	1	1	3	4	2	18	Low	(-)	
Mitigation and Management Measures	— The operation and maintenance phase to be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human health - Chronic exposure to toxic chemical or biological agents									

	— A SHEQ policy to be in place.
	— A detailed risk assessment of all normal operating and maintenance activities on site to be compiled, and form the basis of operating instructions, prior to commencing commissioning.
	— A SHE procedure to be in place, and include but not limited to, PPE specifications, management of change, integrity monitoring.
	— Ensure that relevant SHE appointees are in place.
	— Undertake training of staff on general hazards on site.
	— All necessary health controls/ practices to be in place, e.g. ventilation of confined areas, occupational health monitoring if required and reporting programs in place.
	— Emergency response plan for full operation and maintenance phase to be in place prior to beginning commissioning and to include aspects such as:
	  — appointment of emergency controller,
	  — emergency isolation systems for electricity,
	  — emergency isolation and containment systems for electrolyte,
	  — provision of PPE for hazardous materials response,
	  — provision of emergency facilities for staff at the main office building,
	  — provision of first aid facilities,
	  — first responder contact numbers etc.								

Compromised battery compartment vapours accumulate in the containers, as well as release solids/liquids on surfaces. Maintenance of battery components can cause corrosive and mildly toxic liquid on surfaces. This can result in dermatitis, and skin /eye/lung irritation. The operational impact on human health - chronic exposure to toxic chemical or biological agents is outlined in **Table 7-120**.

Table 7-120: Operational Impact on human health - chronic exposure to toxic chemical or biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - Chronic exposure to toxic chemical or biological agents									
Without Mitigation	2	1	3	5	4	44	Moderate	(-)	Complex
With Mitigation	1	1	3	5	2	20	Low	(-)	
Mitigation and Management Measures	— Maintenance procedures to be in place should equipment need to be opened, e.g. pumps drained and decontaminated prior to repair in workshop etc. — Ensure PPE for handling battery parts and other equipment on site is specified and worn when required. — Training of staff on general hazards on site must be conducted. — Provide signage or labels on all equipment. — Confined space entry procedures if entering tanks and possibly battery containers. — Safety Data Sheets (SDSs) to be available on site. — Operating manuals to be provided including start-up, shut-down, steady state, monitoring requirements.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - Chronic exposure to toxic chemical or biological agents									
	— Maintenance manuals with make safe, decontamination and repair procedures to be in place. — A maintenance schedule must be developed and implemented to include the required daily, weekly, monthly, annual etc maintenance. — Provided portable equipment for calibration and for testing/verification of defective equipment, e.g. volt/current meters, infrared camera								

HUMAN HEALTH - EXPOSURE TO NOISE

Moving parts inside containers, buildings, pumps, compressors, cooling systems etc. can cause adverse impact on hearing of workers, or may be a nuisance factor at near -by residences or other activities. The operational impact on human health - exposure to noise is outlined in **Table 7-121**.

Table 7-121: Operational Impact on human health - exposure to noise

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	2	1	5	5	4	52	Moderate	(-)	Easy
With Mitigation	2	1	5	5	2	26	Low	(-)	
Mitigation and Management Measures	— Design the system to ensure continuous noise does not exceed 85dB within the facilities or at any other location on site or 61 dB at the site boundary, e.g. emergency generator, air compressor etc. — Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.								

HUMAN HEALTH - EXPOSURE TO TEMPERATURE EXTREMES AND/OR HUMIDITY

Workers may be exposed to extreme temperatures and/or humidity such as heat during the day and cold weather in winter. Batteries can also generate heat within enclosed buildings / containers, and night work requires lighting which can generate heat. This could result in heat stroke or hypothermia. The operational impact on human health - exposure to temperature extremes and/or humidity is indicated in **Table 7-122**.

Table 7-122: Operational Impact on human health - exposure to temperature extremes and/or humidity

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	4	2	3	1	2	20	Low	(-)	Easy
With Mitigation	3	2	3	1	1	9	Very Low	(-)	
Mitigation and Management Measures	— Building and container facilities to comply with Occupational Health and Safety Act 85 of 1993 specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. — Suitable lighting to be provided including emergency lighting for safe building exit in the event of power failure. — Adequate potable water to be provided during all phases of the project.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
	— PPE for operations and maintenance staff to be suitable for the weather conditions.								

HUMAN HEALTH - EXPOSURE TO PSYCHOLOGICAL STRESS

Isolated workstation and monotonous repetitive work can cause low performance, and system productivity suffers. The operational impact on human health **-** exposure to psychological stress is outlined in **Table 7-123**.

Table 7-123: Operational Impact on human health - exposure to psychological stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	2	3	3	2	2	20	Low	(-)	Easy
With Mitigation	1	3	3	2	1	9	Very Low	(-)	
Mitigation and Management Measures	— Implement staff rotation to other activities within the site where necessary. — Performance monitoring of inspections / maintenance tasks in particular must be undertaken.								

HUMAN HEALTH - CHRONIC EXPOSURE TO ERGONOMIC STRESS

Lifting heavy equipment and movement at awkward angles during maintenance, stretching to reach high level and bending to low level, including working at heights if equipment is located on top of roofs or elevated electrical equipment (e.g. pylons), can result in back and other injuries. The operational impact on human health **-** exposure to ergonomic stress is outlined in **Table 7-124**.

Table 7-124: Operational Impact on human health - exposure to ergonomic stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	5	1	3	2	3	33	Moderate	(-)	Easy
With Mitigation	4	1	3	2	2	20	Low	(-)	
Mitigation and Management Measures	— Training in lifting techniques must be provided. — Working at heights training must be provided. — If equipment is at height, ensure suitable safe (electrically and physically) ladders / harnesses etc. are available. — A working at height procedure needs to be in place.								

HUMAN AND EQUIPMENT SAFETY – EXPOSURE TO FIRE RADIATION

During the operation of the facility there are chances of involvements in an external fire e.g. veld fire, maintenance vehicle fire, electrical systems fire. Manufacturing defects or damage to batteries leading to shorting and heating can also be an issue along with high humidity condensation of water or ingress of water or flooding leading to shorting. Dust accumulation on electrical parts leading to overheating. Excessive electrical loads and/or surges. Operator abuse, BMS failure or software failure. Incorrect extinguishing mediums can escalate the fire. Consequences include contaminated run off. Radiation burns unlikely to be severe as no highly flammable materials on site. Damaged equipment. Fire spreads to other units or offsite if grass/vegetation not controlled. The operational impact on human and equipment safety **-** exposure to fire radiation is outlined in **Table 7-125**.

Table 7-125: Operational Impact on human and equipment safety - exposure to fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	5	1	5	5	4	48	Moderate	(-)	Complex
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— Grass cutting and fire breaks around the BESS installations. No combustible materials to be stored in or near the batteries or electrical infrastructure, e.g. separation of site diesel tank. Fire resistant barrier between the batteries and the PCS side if in the same container. — The Facility to comply with prescribed design standards such as the BESS design codes from the USA and standards of practice that (e.g. UL9540, NFPA 855 and DNV GL RP 43). — A detailed Failure Modes and Effects Analysis (FMEA) / (Hazard and Operability Analysis (HAZOP) / Bowtie methodology must be developed during design at the component level and system levels. — Conduct safety integrity level rating of equipment (failure probably) with suitable redundancy if required. — Conduct Site Acceptance Testing as part of commissioning of each unit and the overall system. — Abuse tests to be conducted by supplier. — Ensure an effective Battery Management System (BMS) is included in the design. BMS should be checking individual cell voltage as well as stack, module, container, system voltages/current etc. BMS tripping the cell and possibly the stack/ building unit or module/rack/container, if variations in voltage. — Diagnostics must be easily accessible. Diagnostics are able to distinguish cell from stack or cell from module faults. — Fire resistant barrier between the batteries and the PCS side if in the same container, or separate containers must form part of the design. — As per SANS Standards,suitable ingress protection level to be provided for electrical equipment, e.g. IP55 - 66. If air cooling into container, suitable dust filters to be provided if needed. — Install smoke detectors linked to BMS & alerts in control room. — Effects of battery aging to be considered. Temperature monitoring to be in place. Regular infrared scanning. Data needs to be stored for trend analysis. — An Emergency plan, from transport and construction phase, must be extended to operational phase. The plan must include the hazards of the electrically live system. This Plan must include procedures to address solid state container fires - extinguishing, ventilating, entering as appropriate or not. — PPE for container firefighting must include fire retardant, chemically resistant, nitrile gloves, antistatic acid resistant boots, fill face shields, BA sets. — A planned fire response to prevent escalation to an explosion or an environmental event must be developed. — Suitable supply of fire extinguishing medium and cooling medium must be provided. Fogging nozzles can be used to direct smoke. — Ensure procedures in place to clean up after event Lingering toxic residues in the soil and on adjacent structures.									

A Power Conversion System's (PCS – DC to AC) cooling failure can result in electrical fire. The consequence of this is that a fire can start in PCS or another section or room and spread to the battery area. The operational impact on human and equipment safety - exposure to fire radiation is outlined in **Table 7-126**.

Table 7-126: Operational Impact on human and equipment safety - exposure to fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	5	2	5	5	3	**51**	**Moderate**	(-)	Moderate
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	
Mitigation and Management Measures	— Consider separating the VRF building systems PCS from the batteries and other equipment and place it in another area.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO EXPLOSION OVER PRESSURES

Transformer shorting / overheating / explosion can result in potential fatalities amongst first responders; or damage to nearby equipment. The operational impact on human and equipment safety - exposure to explosion over pressures is indicated in **Table 7-127**.

Table 7-127: Operational Impact on human and equipment safety - exposure to explosion over pressures

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures									
Without Mitigation	5	1	5	5	2	**32**	**Moderate**	(-)	Moderate
With Mitigation	5	1	5	5	1	**16**	**Low**	(-)	
Mitigation and Management Measures	— Electrical equipment to be specified to suit application. — An emergency response plan must be in place as referred to above and employee training on the plan must be provided.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ACUTE TOXIC CHEMICAL AND BIOLOGICAL AGENTS

Human pathogens and diseases, sewage, food waste as well as snakes, insects, wild and domesticated animals and harmful plants can cause illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc. The operational impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in **Table 7-128**.

Table 7-128: Operational Impact on human and equipment safety - exposure to acute toxic chemical and biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	1	3	2	3	**30**	**Low**	(-)	Moderate
With Mitigation	3	1	2	2	2	**16**	**Low**	(-)	
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Policies and practice for dealing with known vectors of disease such as Aids, TB, COVID 19 and others must be developed and implemented. — Conduct awareness training for persons on site, safety induction to include animal hazards.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
	— First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. — Due to isolated locations and distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts.								

Damaged battery components, leakage of electrolyte, or if the components are completely broken exposing hazardous chemicals, and thermal runaway and hazardous fumes are released, this can cause mild skin irritation from exposure to small leaks to serious corrosive burns for large exposure. The operational impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in **Table 7-129**.

Table 7-129: Operational Impact on human and equipment safety - exposure to acute toxic chemical and biological agents for VRF BESS

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	3	3	5	3	45	Moderate	(-)	Moderate
With Mitigation	3	3	3	5	2	28	Low	(-)	
Mitigation and Management Measures	— Corrosion resistant PPE (e.g. overalls, gloves, eyeglasses) to be specified for all operations in electrolyte areas. — PPE to be increased (e.g. full-face shield, aprons, chemical suits) for operations that involve opening equipment and potential exposure, e.g. sampling, maintenance. — All operators/maintenance staff trained in the hazards of chemicals on site. — Ensure a 24/7 helpline response. — Adhere to standard dangerous goods requirements for Hazmat labels. — All operators/maintenance staff to be trained in the hazards.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO VIOLENT RELEASE OF KINETIC OR POTENTIAL ENERGY

Moving equipment, pumps, heavy equipment at elevation, nip points, working at heights, traffic accidents and earthquake/tremors can cause injury or possibly fatality in unlikely worst case, damage to equipment, spills, and environment pollution. The operational impact on human and equipment safety - exposure to violent release of kinetic or potential energy is outlined in **Table 7-130**.

Table 7-130: Operational Impact on human and equipment safety - exposure to violent release of kinetic or potential energy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
Without Mitigation	5	1	5	5	3	48	Moderate	(-)	Moderate
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— Maintenance equipment to be serviced and personnel suitably trained in the use thereof. — Traffic signs, rules etc to be in place on site.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
	— All normal working at heights, hot work permits, confined space entry, cordon off unsafe areas/works etc procedures to be in place. — An emergency response plan must be in place. — Civil design to take seismic activity into account.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ELECTROMAGNETIC WAVES

The operational phase will include the use of electrical machines, generators etc. In hot dry areas, static generation is highly likely, as well as lightning strike. This may cause electrocution, ignition, burns, injury and death, as well as damage to electrical equipment. The operational impact on human and equipment safety - exposure to electromagnetic waves is outlined in **Table 7-131.**

Table 7-131: Operational Impact on human and equipment safety - exposure to electromagnetic waves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
Without Mitigation	5	2	5	5	3	**51**	**Moderate**	(-)	Complex
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	
Mitigation and Management Measures	— Adhere to codes and guidelines for electrical insulation. — Provide suitable PPE. — Low voltage equipment (e.g. batteries) to be separated from high voltage (e.g. transmission to grid). — Personnel to be trained in line with IEE 1657 – 2018 (Recommended Practice for Personnel Qualifications for Installation and Maintenance of Stationary Batteries). — Adhere to Eskom Operating Regulations for high voltage systems including access control, permit to work, safe work procedures, live work, abnormal and emergency situations, keeping records. — Consider suitably located Emergency stop buttons for the facility and the other equipment on site. — Software also need to be kept as update to date as reasonably practicable. — Consider suitably located Emergency stop buttons for the facility and the other equipment on site. — PPE to consider static accumulation for entering the facility, and particularly the battery containers especially after a high temperature shut down where there could possibly be flammable materials. — The procedures for responding to alarm and auto shut down on containers, needs to consider that there may be a dangerous environment inside and how to protect personnel who may enter to respond. — All outside work must be stopped during thunder storms. — Lighting conductors may be required for the installation, to be confirmed during design									

ENVIRONMENT - EMISSIONS TO AIR

Refrigerant may be an asphyxiant if accidentally released indoors it can accumulate and displace oxygen. It is however noted that this is not expected on a normal basis. The operational impact on environment - emissions to air is outlined in **Table 7-132**.

Table 7-132: Operational Impact on environment - emissions to air

Potential Impact Environment – emissions to air	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	1	1	1	3	**18**	**Low**	(-)	Easy
With Mitigation	3	1	1	1	1	**6**	**Very Low**	(-)	
Mitigation and Management Measures	— Containers could be treated as entering a confined space and similar procedures entering confined spaces could be in place, e.g. do not enter alone, gas testing prior to entering, ensure adequate ventilation. Particularly after any warning alarms have gone off, but possibly even normally.								

ENVIRONMENT - EMISSIONS TO WATER

Waste will be generated during the operation of the facility. This may include cooling water blow-down, laboratory waste (if included in the design), maintenance waste, e.g. oils, spills from batteries, coolant system, diesel trucks, transformers, oil drips from parked vehicles, fire water runoff control, kitchen waste and sewage, refrigerant release or VRF electrolyte purging. These can cause pollution if not contained and excessive disposal costs if emissions not limited. These can cause pollution if not contained and excessive disposal costs if emissions are not limited. The operational impact on environment - emissions to water is outlined in **Table 7-133**.

Table 7-133: Operational Impact on environment - emissions to water

Potential Impact Environment - emissions to water	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	2	3	2	3	**30**	**Low**	(-)	Moderate
With Mitigation	3	2	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Electrolyte areas to be fully bunded to 110% of largest tank, or more. — Implement bunding under any outdoors tanks, curbing under truck offloading areas and sealed surfaces (e.g. concrete) under truck parking area. — Provide containment and suitable treatment/disposal for sewage and any kitchen liquids. — Procedures for dealing with damaged/leaking equipment as well as clean-up of spills to be in place and implemented. — Conduct normal site practices for preventing and containing diesel/paint etc spills. — Waste management plan to be in place and provide measures for, but not limited to, liquid waste treatment or suitable removal and disposal. — Spill clean-up procedures to be in place before bringing container on site, including spill kits – non-combustible materials, hazmat disposal. — Undertake reporting of reportable quantities in line with NEMA. — Process controls to be in place to prevent contamination and deterioration of electrolyte leading to excessive purging. — Ensure proposed locations of the BESS facilities are a suitable distance from the closest water course. In the event of a major								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
	spill if this is too close it may not allow time for mitigation to be taken. Adequate secondary and possibly tertiary containment systems may then be needed on site.								

ENVIRONMENT - EMISSIONS TO EARTH

The operation phase will generate solid waste. The disposal of battery components can cause environmental damage. The operational impact on environment **-** emissions to earth is outlined in **Table 7-134**.

Table 7-134: Operational Impact on environment - emissions to earth

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to earth									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Easy
With Mitigation	2	2	3	3	1	**10**	**Very Low**	(-)	
Mitigation and Management Measures	— Implement system for waste segregation (e.g. electronic equipment, chemicals) and management on the site.								

ENVIRONMENT – WASTE OF RESOURCES

The operation phase will require the usage of water and power. Operations will include the disposal of batteries or components. However, if the usage is not controlled it will result in wastages. Excessive purging of deteriorated or contaminated electrolyte may occur. These may result in delays, excessive costs and disposal of large volumes of hazardous waste. The operational impact on environment **-** waste of resources e.g. water, power etc is outlined in **Table 7-135**.

Table 7-135: Operational Impact on environment - waste of resources e.g. water, power etc

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	2	1	1	2	4	**24**	**Low**	(-)	Easy
With Mitigation	2	1	1	2	2	**12**	**Very Low**	(-)	
Mitigation and Management Measures	— Water usage to be monitored on site. — Handling protocols to be provided by supplier of electrolyte. — Water management plan and spill containment plans to be in place. — Investigate end of Life plan for electrolyte batteries including options for reuse / recovery / reconditioning. — Similarly, for decommissioned containers / equipment, consider reuse / recovery / repurpose.								

PUBLIC - AESTHETHICS

Bright surfaces reflecting light and tall structures in a flat area may cause irritation. The operational impact on public **-** aesthetics is outlined in **Table 7-136**.

Table 7-136: Operational Impact on public - aesthetics

Potential Impact Public - Aesthetics	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	2	4	4	4	**48**	**Moderate**	(-)	Moderate
With Mitigation	1	2	4	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Visual impact assessment to include BESS installation when design details become available. Confirm any height limitations for VRFB BESS building (if utility scale).								

INVESTORS - FINANCIAL

The result of possible defective technology and extreme project delays can cause financial loss. The operational impact on investors - financial is outlined in **Table 7-137**.

Table 7-137: Operational Impact on investors - financial

Potential Impact Investors - Financial	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	5	1	3	4	3	**39**	**Moderate**	(-)	Easy
With Mitigation	3	1	3	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Undertake adequate research during the planning and design phase to select the supplier and/contractor with the best technology that is internationally recognized and proven. — Project management with deviation monitoring.								

EMPLOYEES AND INVESTORS – SECURITY

On route to the operational site there is a risk of potential hi-jacking of valuable but hazardous loads. On site there is a risk of theft of operational equipment and battery installation facilities. There may also be civil unrest or violent strike by employees. This may result in theft, injury to burglars, damage to equipment possibly setting off thermal runaway. The operational impact on employees and investors – security is outlined in **Table 7-138**.

Table 7-138: Operational Impact on employees and investors – security

Potential Impact Employees and investors - Security	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	1	3	2	4	**36**	**Moderate**	(-)	Moderate
With Mitigation	3	1	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Fencing around electrical infrastructure to adhere to SANS standard and Eskom Guidelines. — Consider motion detection lights and CCTV. — The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g. Skull and Cross Bones or other signs. — Night lighting to be provided both indoors and outdoors where necessary.								

Cyber security attacks aimed at the National Electricity Grid may result in the ransom of the National Electricity Grid. The operational impact on employees and investors – security is indicated in **Table 7-139**.

Table 7-139: Operational Impact on employees and investors – security

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	4	4	3	1	4	48	Moderate	(-)	Complex
With Mitigation	4	4	3	1	2	24	Low	(-)	
Mitigation and Management Measures	— Cyber security needs monitoring. — Remote access to system needs to be negotiated and controlled. — Install password controls, levels of authority etc. Protection of the National Electricity Grid from Cyber-attacks accessing through the BESS to be implemented. — Cyber emergency procedures should be in place prior to commissioning.								

EMERGENCIES

During the operational phase, there is the potential for fires, explosions, noxious smoke, large spills, traffic accidents and equipment/structural collapse. Inadequate emergency response to small event can lead to escalation. Consequences of these include injuries which can turn to fatalities, and small losses become extended down time. The operational impact on emergencies is outlined in **Table 7-140**.

Table 7-140: Operational Impact on emergencies

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Emergencies									
Without Mitigation	4	2	3	4	3	39	Moderate	(-)	Complex
With Mitigation	4	2	3	4	2	26	Low	(-)	
Mitigation and Management Measures	— All safety measures listed above must be implemented. — Emergency procedures need to be practiced prior to commencement of operations. — Escape doors should swing open outwards and not into the building/container. — There must be more than one exit from buildings.								

INVESTORS LEGAL

The battery industry is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. This may result in unknown hazards that may manifest due to using "cheaper supplier or less developed technology". The operational impact on investors – legal is indicated in **Table 7-141**.

Table 7-141: Operational Impact on investors – legal

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Without Mitigation	3	1	3	3	4	40	Moderate	(-)	Moderate
With Mitigation	3	1	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— Use only internationally reputable battery suppliers who comply with all known regulations/guideline at the time of purchasing. — Ensure only latest state of the art battery system are used and not old technologies prone to fires/explosions etc..								

7.13.3 DECOMMISSIONING PHASE

SOLID STATE LITHIUM-ION AND VANADIUM REDOX FLOW BATTERY ENERGY STORAGE SYSTEMS

Battery components may have a limited lifespan, there are damaged equipment, waste electrolyte etc. There could already be "waste" on the first day of commissioning and plans should be in place to deal with this. Ideally an End-of-Life plan needs to be in place before the first electrolyte / container / equipment is brought on site.

HUMAN HEALTH - CHRONIC EXPOSURE TO TOXIC CHEMICAL OR BIOLOGICAL AGENTS

The decommissioning impact on human health - chronic exposure to toxic chemical or biological agents is outlined in **Table 7-142**.

Table 7-142: Decommissioning Impact on human health - chronic exposure to toxic chemical or biological agents for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human health - Chronic exposure to toxic chemical or biological agents									
Without Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	Easy
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN HEALTH - EXPOSURE TO NOISE

The decommissioning impact on human health - exposure to noise is outlined in **Table 7-143**.

Table 7-143: Decommissioning Impact on human health - exposure to noise for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	Easy
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN HEALTH - EXPOSURE TO TEMPERATURE EXTREMES AND/OR HUMIDITY

The decommissioning impact on human health - exposure to noise is outlined in **Table 7-144**.

Table 7-144: Decommissioning Impact on human health - exposure to temperature extremes and/or humidity for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	Easy
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN HEALTH - EXPOSURE TO PSYCHOLOGICAL STRESS

The decommissioning impact on human health - exposure to psychological stress is outlined in **Table 7-145**.

Table 7-145: Decommissioning Impact on human health - exposure to psychological stress for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	Easy
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN HEALTH - CHRONIC EXPOSURE TO ERGONOMIC STRESS

The decommissioning impact on human health - exposure to ergonomic stress is outlined in **Table 7-146**.

Table 7-146: Decommissioning Impact on human health - exposure to ergonomic stress for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	High
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	High
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN AND EQUIPMENT SAFETY – EXPOSURE TO FIRE RADIATION

The decommissioning impact on human and equipment safety - exposure to fire radiation is outlined in **Table 7-147**.

Table 7-147: Decommissioning Impact on human and equipment safety - exposure to fire radiation for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	Easy
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO EXPLOSION OVER PRESSURES

The decommissioning impact on human and equipment safety - exposure to explosion over pressures is outlined in **Table 7-148**.

Table 7-148: Decommissioning Impact on human and equipment safety - exposure to explosion over pressures for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures									
Without Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	Easy
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ACUTE TOXIC CHEMICAL AND BIOLOGICAL AGENTS

The decommissioning impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in **Table 7-149**.

Table 7-149: Decommissioning Impact on human and equipment safety - exposure to acute toxic chemical and biological agents for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO VIOLENT RELEASE OF KINETIC OR POTENTIAL ENERGY

The decommissioning impact on human and equipment safety - exposure to violent release of kinetic or potential energy is outlined in **Table 7-150**.

Table 7-150: Decommissioning Impact on human and equipment safety - exposure to violent release of kinetic or potential energy for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ELECTROMAGNETIC WAVES

The decommissioning impact on human and equipment safety - exposure to electromagnetic waves is outlined in **Table 7-151.**

Table 7-151: Decommissioning Impact on human and equipment safety - exposure to electromagnetic waves for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

ENVIRONMENT - EMISSIONS TO AIR

The decommissioning impact on environment - emissions to air is outlined in **Table 7-152**.

Table 7-152: Decommissioning Impact on environment - emissions to air for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

ENVIRONMENT - EMISSIONS TO WATER

The decommissioning impact on environment - emissions to water is outlined in **Table 7-153**.

Table 7-153: Decommissioning Impact on environment - emissions to water for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

ENVIRONMENT - EMISSIONS TO EARTH

Batteries / equipment will reach its end of life and may leak. This may result in environment damage from heavy metal ions. The decommissioning impact on environment - emissions to earth is outlined in **Table 7-154**.

Table 7-154: Decommissioning Impact on environment - emissions to earth for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to earth									
Without Mitigation	4	3	3	5	4	60	Moderate	(-)	Complex
With Mitigation	4	3	3	5	2	30	Low	(-)	
Mitigation and Management Measures	— Develop and implement End of Life shutdown procedure including a risk assessment of the specific activities involved. — Re-purpose the solid-state batteries / containers and equipment with associated Environmental impact considered. — Undertake disposal according to local regulations and other directives such as the European Batteries Directive. — End of life can be predefined and the monitoring can be in place to determine if it has been reached. — Consider impact of temperature and time, cycles								

ENVIRONMENT – WASTE OF RESOURCES

The decommissioning impact on environment - waste of resources e.g. water, power etc is outlined in **Table 7-155**.

Table 7-155: Decommissioning Impact on environment - waste of resources e.g. water, power etc for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Mitigation and Management Measures	— As per construction and operational phases.								

PUBLIC - AESTHETICS

The decommissioning impact on public - aesthetics is outlined in **Table 7-156**.

Table 7-156: Decommissioning Impact on public - aesthetics for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

INVESTORS - FINANCIAL

The decommissioning impact on investors - financial is indicated in **Table 7-157**.

Table 7-157: Decommissioning Impact on investors - financial for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
INVESTORS - FINANCIAL									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

EMPLOYEES AND INVESTORS – SECURITY

The decommissioning impact on employees and investors – security is outlined in **Table 7-158**.

Table 7-158: Decommissioning Impact on employees and investors – security for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

EMERGENCIES

The decommissioning impact on emergencies is outlined in **Table 7-159**.

Table 7-159: Decommissioning Impact on emergencies for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
EMERGENCIES									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
EMERGENCIES									
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

INVESTORS LEGAL

Disposal of hazardous "waste" is rife with difficulties and numerous regulations that need to be complied with. The decommissioning impact on investors – legal is outlined in **Table 7-160**.

Table 7-160: Decommissioning Impact on investors – legal for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Without Mitigation	3	1	3	3	4	**40**	**Moderate**	(-)	Complex
With Mitigation	3	1	3	3	3	**30**	**Low**	(-)	
Mitigation and Management Measures	— Applicants should seek the opinion from a waste consultant on how to correctly dispose of hazardous waste.								

7.14 NO-GO ALTERNATIVE

The no-go alternative is essentially the option of not developing powerlines or substations in this area in which case none of the negative and positive impacts described above will come into effect.

The area would thus retain its visual character and sense of place and no visual impacts would be experienced by any locally occurring receptors.

The no-go alternative considers impacts that will occur to the project area in the absence of the proposed development. There is no agricultural impact of the no-go option. Therefore, the extent to which the development (insignificant impact) and the no-go alternative will impact the current land use is more or less equal, which results in there being, from an agricultural impact perspective only, no preferred alternative between the development and the no-go. However, the no-go option would prevent the proposed Mukondeleli WEF from contributing to the environmental, social and economic benefits associated with the development of renewable energy in South Africa.

The no-go alternative will result in the current status quo being maintained at the proposed development site as far as all the specialist studies concerned. The no-go option would maintain the natural habitat which would be beneficial to the avifauna currently occurring there.

The proposed OHPL and substations are essential to enable the Mukondeleli WEF to assist Sasol's intent to lead the energy transition in South Africa. Sasol's goal is to reduce its greenhouse gas footprint for Scope 1 and 2 emissions by 30% by 2030 and achieve Net Zero by 2050. This will be achieved through a combination of energy and process efficiencies, strategic partnerships, investments in renewables and a shift to incremental natural gas as a transition feedstock and ultimately green hydrogen and sustainable carbon for the Southern African value chain.

8 CUMULATIVE IMPACT ASSESSMENT

Although the objective of the NEMA Basic Assessment process is to undertake an impact and risk assessment process, inclusive of cumulative impacts, which is essential to assessing and managing the environmental and social impacts of projects, it may be insufficient for identifying and managing the incremental impacts on areas or resources used or directly affected by a given development from other existing, planned, or reasonably defined developments at the time the risks and impacts are identified.

IFC PS 1 recognizes that, in some instances, cumulative effects need to be considered in the identification and management of environmental and social impacts and risks. For private sector management of cumulative impacts, IFC considers good practice to be two pronged:

- effective application of and adherence to the mitigation hierarchy in environmental and social management of the specific contributions by the project to the expected cumulative impacts; and
- best efforts to engage in, enhance, and/or contribute to a multi-stakeholder, collaborative approach to implementing management actions that are beyond the capacity of an individual project proponent.

Even though Performance Standard 1 does not expressly require, or put the sole onus on, private sector clients to undertake a cumulative impact assessment (CIA), in paragraph 11 it states that the impact and risk identification process "*will take into account the findings and conclusions of related and applicable plans, studies, or assessments prepared by relevant government authorities or other parties that are directly related to the project and its area of influence*" including "*master economic development plans, country or regional plans, feasibility studies, alternatives analyses, and cumulative, regional, sectoral, or strategic environmental assessments where relevant*."

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities (IFC GPH).

Evaluation of potential cumulative impacts is an integral element of an impact assessment. In reference to the scope for an impact assessment, IFC's Performance Standards specify that "*Risks and impacts will be analysed in the context of the project's area of influence. This area of influence encompasses…areas potentially impacted by cumulative impacts from further planned development of the project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken; and (iv) areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.*" (IFC 2006).

A cumulative impact assessment is the process of (a) analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen Valued Environmental and Social Components (VECs) over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible (IFC GPH).

Cumulative impacts with existing and planned facilities may occur during construction and operation of the proposed OHPL and substation. While one project may not have a significant negative impact on sensitive resources or receptors, the collective impact of the projects may increase the severity of the potential impacts.

Therefore, a number of renewable energy developments within the surrounding area which have submitted applications for environmental authorisation (some of which have been approved and others now operational). It is important to note that the existence of an approved EA does not directly equate to actual development of the project.

These existing surrounding projects of varying approval status have been detailed in **Table 8.1.**

Potential cumulative impacts identified are summarised below

Table 8.1: Existing surrounding projects within a 55km radius of the Mukondeleli WEF and OHPL

DFFE REFERENCE	PROJECT TITLE	STATUS
14/12/16/3/3/2/754	Tutuka 65.9 MW Solar Photovoltaic (PV) Energy Facility and its associated infrastructure (Ref:) located 23km southwest of the site	Approved
14/12/16/3/3/1/452	Forzando North Coal Mine Solar PV Facility, 9.5MW, (Ref:) is located 55km northwest of the site	Approved
1/3/1/16/1 G-269	Proposed Impumelelo WEF to be located southeast of the site	In progress
MPP/EIA/0001063/2022	Proposed Vhuvhili Solar Energy Facility (NEAS No.) located approximately 10km east of the site	In progress

8.1 AGRICULTURE CUMULATIVE IMPACTS

The potential cumulative agricultural impact of importance is a regional loss of future agricultural production potential. The defining question for assessing the cumulative agricultural impact is this:

> *What level of loss of future agricultural production potential is acceptable in the area, and will the loss associated with the proposed development, when considered in the context of all past, present or reasonably foreseeable future impacts, cause that level in the area to be exceeded*?

There are a number of non-agricultural developments that are leading to loss of agricultural production potential in the area. However, because this grid connection itself leads to a very small loss of production potential, its cumulative impact is low. It therefore does not make sense to conduct a more formal assessment of the development's cumulative impacts as per DFFE requirements for cumulative impacts. Many times more electricity grid infrastructure than currently exists, or is currently proposed, can be accommodated before acceptable levels of change in terms of loss of production potential are exceeded. In reality the landscape in this environment could be covered with powerlines and agricultural production potential would be minimally affected.

Due to the considerations discussed above, the cumulative impact of loss of future agricultural production potential can confidently be assessed as being low and therefore having an acceptable impact on the area. In terms of cumulative impact, the proposed development is therefore acceptable and it is therefore recommended that it be approved.

8.2 AQUATIC CUMULATIVE IMPACTS

In terms of drainage the Boesmanpruitnand Grootbessiespruit watercourses, their tributaries which surround the proposed powerline and substation all ultimately drain into the Vaal River which is a very important and strategic water source of South Africa, and all care should be taken to protect the Vaal River from further pollution and other impacts.

Research on SEF's environmental impact especially cumulative impacts are still limited (Rudman et al., 2017). On a landscape level the following are within the 10 km radius of the planned SEF:

— Agricultural activities;
— Roads;
— Sasol Secunda Operations;
— Town of Secunda

During the construction phase it is likely that vegetative cover as well as disturbance of soil will increase the prevalence of erosion and subsequently the amount of sediment present in the catchment. It is also foreseen that during the construction phase the disturbance caused can increase the spread of alien invasive plant species. It is expected that during the operational phase the impact on hydrological regime will be higher due to the cumulative impacts of the WEF, SEF, grid solutions and supporting infrastructure.

In terms of aquatic biodiversity, the major cumulative impact is thought to be an increase in concentrated flows due to increase in runoff.

8.3 BIODIVERSITY CUMULATIVE IMPACTS

VEGETATION LOSS AND HABITAT DESTRUCTION

Vegetation loss, habitat destruction and possibly loss of SCC, can occur when considering all developments. The habitat destruction will lead to changes in the physical features of the habitat, with concomitant changes in ecological processes. Secondary vegetation will develop at sites where the vegetation was cleared or the soil compacted. The species composition may change and alien species might invade. Vegetation loss will also constitute the loss of animal habitat. It should however be noted that in the case of wind energy facilities vegetation loss due to habitat destruction is far more contained than in the case of solar facilities. The contribution by the Mukondeleli gridline site to the cumulative impact will be small (**Table 8-2**).

Table 8-2: Cumulative Impact on vegetation loss and habitat destruction

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Vegetation loss and habitat destruction									
Without Mitigation	5	3	3	4	3	**45**	**Moderate**	(-)	Moderate
With Mitigation	3	3	3	4	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— All projects should adhere to the site-specific recommendations of the ecologists to ensure that impacts are mitigated where possible. — Placement of infrastructure should be done in such a way that no SCC are affected and CBAs avoided. — Location of the pylons in the most environmentally responsible manner is — Maintain a vegetation ground layer along the roads in the servitude.								

COMPROMISING INTEGRITY OF CBA, ESA AND NPAES

According to the mapping of CBAs in Mpumalanga, some sections of the gridline are located/partially located within CBAs in the current layout. Development within CBAs is not encouraged as such development may result in biodiversity loss and therefore compromise the integrity of the CBA. Although there are currently only two projects within 50 km from the Mukondeleli site, this could in future change and the integrity of the CBAs could be compromised and consequently the biodiversity target for the ecosystem could be affected. The development does not affect a NPAES (2010) and is not earmarked for expansion in the Mpumalanga PAES within a 5-year span. The contribution of the Mukondeleli gridline to this cumulative impact will be small. .

It is assumed that authorisation would only be granted to projects that have similarly avoided CBAs (**Table 8-3**).

Table 8-3: Cumulative Impact on CBA, ESA and NPAES

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Compromising integrity of CBA, ESA and NPAES									
Without Mitigation	5	3	3	4	3		**Moderate**	(-)	Moderate
With Mitigation	3	3	3	4	2		**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Compromising integrity of CBA, ESA and NPAES									
Mitigation and Management Measures	— Placement of infrastructure should strive to avoid CBAs. — Minimise the development footprint as far as possible. — Maintain a vegetation ground layer in the gridline servitude. — Stringent construction-phase monitoring of activities at the site to ensure that mitigation measures are adhered to and that the overall ecological impact of the development is maintained at a low level. — Align roads and other infrastructure so that transformation within the CBAs is minimised. — The use of structures which may inhibit movement of fauna, e.g. mesh or electric fencing should be avoided, where feasible.								

REDUCED ABILITY TO MEET CONSERVATION OBLIGATIONS & TARGETS

The loss of unprotected vegetation types on a cumulative basis from the area may impact the countries' ability to meet its conservation targets. Very few statutorily conserved areas occur in the Vulnerable Soweto Highveld Grassland and almost half of it has been transformed mostly by cultivation, plantations, mining and urbanisation. It has a conservation target of 24% and was classified as Not Protected (0.6%) in the 2018National Biodiversity Assessment (Skowno et al. 2018). The layout of the Mukondeleli WEF should be amended to fall within the heavily and moderately transformed areas wherever possible. These transformed areas have already been included in the transformed % for the vegetation type and will thus not affect its conservation status. However, the Mukondeleli site is not located in a protected area nor does it fall within a protected area expansion strategy and thus will not have an impact on the expansion of Protected Areas (**Table 8-4**).

Table 8-4: Cumulative Impact on meeting conservation obligations and targets

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Reduced ability to meet conservation obligations & targets									
Without Mitigation	5	3	3	4	3	**45**	**Moderate**	(-)	Moderate
With Mitigation	3	3	3	4	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— Avoid highly sensitive habitats and CBAs.. — Minimise the development footprint as far as possible.								

LOSS OF LANDSCAPE CONNECTIVITY AND DISRUPTION OF BROAD-SCALE ECOLOGICAL PROCESSES

The gridline could pose a minimal threat to the connectivity of the landscape. For fauna the disruption would depend largely on whether a ground layer of vegetation will be maintained in the servitude or not. Subterranean species that have to emerge from the soil to cross roads will be affected. The severity of these impacts for subterranean species is likely to be relatively low as the roads required for operation are likely to still be of a natural surface such as gravel and would experience low traffic volumes.

If a ground layer of vegetation is maintained beneath the gridline, the facility is unlikely to disrupt pollination and dispersal processes that could cause spatial fragmentation of population (**Table 8-5**).

Table 8-5: Cumulative Impact on landscape connectivity and disruption of broad-scale ecological processes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of landscape connectivity and disruption of broad-scale ecological processes									
Without Mitigation	5	3	3	4	3	45	Moderate	(-)	Moderate
With Mitigation	3	3	3	4	2	26	Low	(-)	
Mitigation and Management Measures	— Minimising the development footprint wherever possible. — Revegetation of all cleared and bare areas created by the facility with local plant species. — Fences and other structures which impede faunal movement should be avoided. — Roads should not have steep curbs.								

8.4 AVIFAUNA CUMULATIVE IMPACTS

The total length of overhead 132kV powerlines for proposed Mukondeleli Grid Connection is approximately 8.0km. There is a total length of approximately 1170km of overhead high voltage (132kV / 400kV) powerlines in a 30km radius of the development area, although for the purpose of this avifaunal risk assessment, this can be reduced to a functional length approximately 600km, given several overhead powerlines run parallel for part of their respective lengths (**Figure 8-1**).

The Mukondeleli Grid Connection therefore represents a comparatively **Low** contribution towards the total length of high voltage power lines within a 30km radius. However, this project will increase the density of planned and existing high voltage lines within a 30km radius, and this cumulative effect represents a potentially **Moderate** impact risk to priority avifauna.

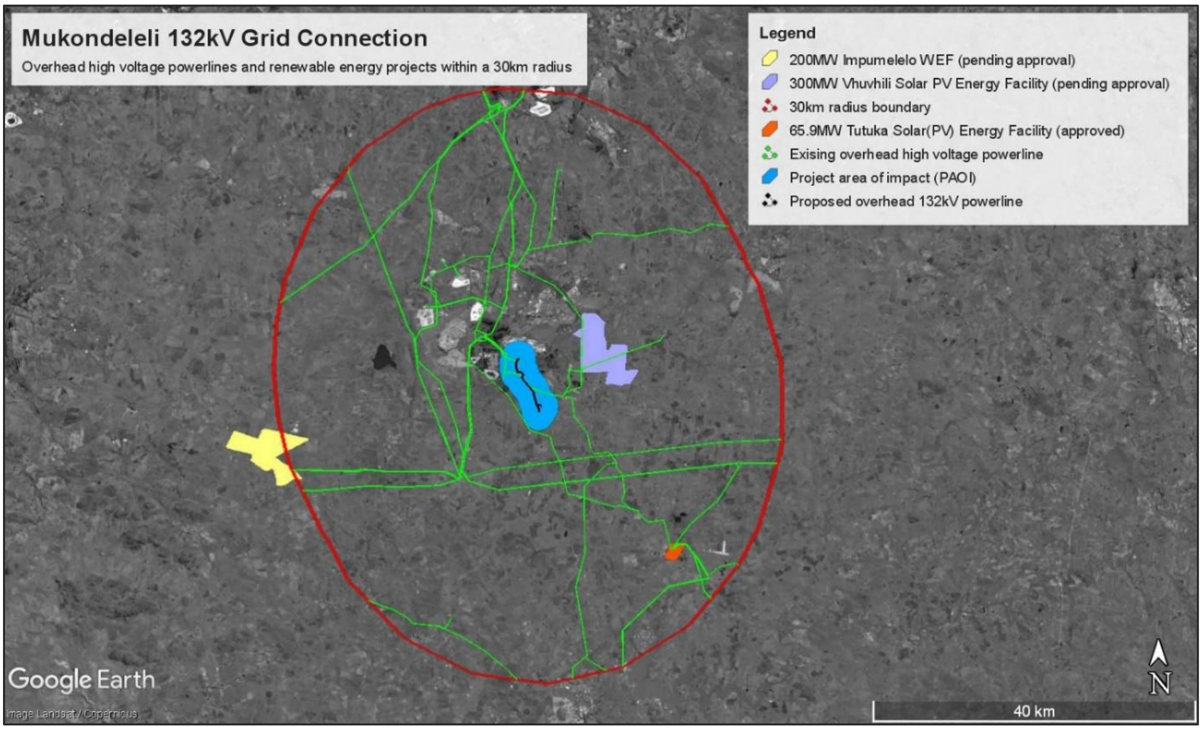


Figure 8-1: Existing overhead high voltage powerlines and proposed renewable energy projects within 30km of the proposed Mukondeleli Grid Connection (source: DFFE Database 2022).

8.5 VISUAL CUMULATIVE IMPACTS

Although it is important to assess the visual impacts of the proposed Mukondeleli EGI specifically, it is equally important to assess the cumulative visual impact that could materialise as a result of this development. Cumulative impacts occur where existing or planned developments, in conjunction with the proposed development, result in significant incremental changes in the broader study area. In this instance, such developments would include:

— existing mining / quarrying activities,

— existing industrial development including the Sasol Secunda synthetic fuel plant; and

— other existing / proposed renewable energy facilities within a 30km radius.

Existing mining / quarrying and industrial development have already resulted in large scale visual impacts, especially to the north of the Mukondeleli EGI study area. These developments have significantly altered the sense of place and visual character in the broader region.

Renewable energy facilities have the potential to cause large-scale visual impacts, and although the level of transformation already present in the landscape will reduce the contrast and overall visual impact of the new development, the incremental change in the landscape will be increased and the visual impacts on surrounding visual receptors would be exacerbated. The South African Renewable Energy EIA Application Database from DFFE (REEA_OR_2022_Q2) records only one approved renewable project within 30kms of the Mukondeleli EGI project area, this being a Solar Photovoltaic (PV) facility located at the Tutuka Power Station. This project is however some 23 km south-east of the Mukondeleli EGI project area, and it is not anticipated that this development will result in any significant cumulative impacts affecting the landscape or the visual receptors within the visual assessment zone for the Mukondeleli EGI.

However, it is known that the Mukondeleli EGI project forms part of a larger Renewable Energy cluster of projects proposed in the greater Secunda area. This complex, including wind (Impumelelo and Mukondeleli WEFs) and solar facilities (Vhuvhili SEF) as well as associated grid connection infrastructure, will affect a large portion of the study area.

From a visual perspective, the concentration of renewable energy facilities in close proximity to existing mining and industrial development as proposed will further change the visual character of the area on the periphery of the Secunda / EMbalenhle urban areas and alter the inherent sense of place, extending an increasingly industrial character into the broader area, and resulting in significant cumulative impacts. It is however anticipated that these impacts could be mitigated to acceptable levels with the implementation of the recommended mitigation measures. In addition, it is possible that these developments in close proximity to each other could be seen as one large Renewable Energy Facility (REF) rather than several separate developments. Although this will not necessarily reduce impacts on the visual character of the area, it could potentially reduce the cumulative impacts on the landscape.

The cumulative visual and landscape impact and associated mitigation measures are outlined in **Table 8-6**.

Table 8-6: Cumulative Impact on the visual landscape

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impacts									
Without Mitigation	4	3	3	5	4	64	High	(-)	Moderate
With Mitigation	4	3	3	4	4	56	Moderate	(-)	
Mitigation and Management Measures	— Carefully plan to minimise the construction period and avoid construction delays. — Position laydown areas and related storage/stockpile areas in unobtrusive positions in the landscape, where possible. — Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. — Where possible, the operation and maintenance buildings should be consolidated to reduce visual clutter.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Visual impacts								
	— As far as possible, limit the number of maintenance vehicles which are allowed to access the facility. — Ensure that dust suppression techniques are implemented on all gravel access roads. — As far as possible, limit the amount of security and operational lighting present on site whilst adhering to relevant safety standards. — Light fittings for security at night should reflect the light toward the ground and prevent light spill. — Lighting fixtures should make use of minimum lumen or wattage whilst adhering to relevant safety standards. — Mounting heights of lighting fixtures should be limited, or alternatively foot-light or bollard level lights should be used. — If possible, make use of motion detectors on security lighting.							

8.6 HERITAGE CUMULATIVE LANDSCAPES

Various other projects are proposed in the wider area and might impact upon heritage resources. Cumulative impacts would occur through the construction, operation and decommissioning of many projects in the same general area. In terms of archaeology, the magnitude and probability would increase but mitigation would still bring the significance down from high negative to very low negative. Graves are generally unlikely to be impacted but are present widely in the landscape and one graveyard in the Mukondeleli WEF project is at risk of impacts. Mitigation would reduce the impact significance from very high negative to very low negative. Cumulative impacts to the landscape are likely to be moderate negative both before and after mitigation for all three phases.

The powerline would not be built without the WEF which means the socio-economic benefit are connected to the WEF. The proposed WEF will be providing electricity to South Africa which will result in obvious benefits to society at many levels. The powerline would transfer that electricity to the National Grid. There will be local job creation during construction and operation but, more widely, an improvement in electricity supply in South Africa will stimulate the economy and result in new job opportunities opening up and quality of life improving. These are clear economic and social benefits and, if mitigation is applied as suggested above, then the socio-economic benefits outweigh the residual impacts.

There are currently no obvious threats to heritage resources on the site aside from the natural degradation, weathering and erosion that will affect archaeological materials. Trampling from grazing animals and/or farm/other vehicles could also occur. These impacts would be of negligible negative significance. The local landscape, which is generally agricultural in nature, is, as noted above, already impacted by the Sasol facility and coal mines. Although the significance of this impact could be considered as moderate to high negative, such facilities are an expected part of the Highveld landscape and have been for many years.

IMPACTS TO ARCHAEOLOGICAL RESOURCES

The cumulative impacts as well as the mitigation measures are outlined in **Table 8-7**Table 7-40.

Table 8-7: Cumulative Impact on archaeological resources

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Damage to or destruction of archaeological resources									
Without Mitigation	3	3	5	5	5	**80**	**High**	(-)	High
With Mitigation	1	3	5	5	1	**14**	**Very Low**	(-)	

IMPACTS TO GRAVES

The cumulative impacts as well as the mitigation measures are outlined in **Table 8-8.**

Table 8-8: Cumulative Impact on graves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Damage to or destruction of graves									
Without Mitigation	5	3	5	5	5	**90**	**Very High**	(-)	High
With Mitigation	1	3	5	5	1	**14**	**Very Low**	(-)	

IMPACTS TO THE CULTURAL LANDSCAPE

The cumulative impacts as well as the mitigation measures are outlined in **Table 8-9**.

Table 8-9: Cumulative Impact on cultural landscapes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual intrusion into and change of character of the cultural landscape									
Without Mitigation	2	3	3	2	5	**50**	**Moderate**	(-)	High
With Mitigation	1	3	3	2	5	**45**	**Moderate**	(-)	

8.7 SOCIAL CUMULATIVE IMPACTS

SENSE OF PLACE

The Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts associated with wind farms on landscapes. These issues raised in these guidelines as to what defines a cumulative impact are also regarded as pertinent to transmission lines. The relevant issues identified by Scottish Natural Heritage study include:

- Combined visibility (whether two or more transmission lines) will be visible from one location).
- Sequential visibility (e.g. the effect of seeing two or more two or more transmission lines) along a single journey, e.g. road or walking trail).
- The visual compatibility of different two or more transmission lines in the same vicinity.
- Perceived or actual change in land use across a character type or region.
- Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

There are existing transmission lines associated with the Secunda facility and the mines in the area. The potential for cumulative impacts associated with combined visibility (whether two or more power lines will be visible from one location) and sequential visibility (e.g., the effect of seeing two or more power lines along a single journey, e.g., road or walking) does therefore exist. However, the cumulative impact on the areas sense of place is likely to be low. In this regard the areas sense of place is dominated by the large industrial Secunda facility and associated mining activities. None of the landowners interviewed raised concerns regarding the potential visual impact on the areas sense of place. The cumulative impact on the sense of place and the landscape is outlined in **Table 8-10.**

Table 8-10: Cumulative Impact on sense of place and the landscape

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impacts associated with the establishment of more than one REF and the potential impact on the area's rural sense of place and character of the landscape.									
Overall impact of the proposed project considered in isolation	2	2	1	4	3	**27**	**Low**	(-)	Moderate
Cumulative impact of the project and other projects in the area	2	3	1	4	3	**40**	**Moderate**	(-)	
Mitigation and Management Measures	— Recommendations of the VIA and SIA should be implemented.								

9 ENVIRONMENTAL IMPACT STATEMENT

The essence of any impact assessment process is aimed at ensuring informed decision-making, environmental accountability, and to assist in achieving environmentally sound and sustainable development. In terms of NEMA, the commitment to sustainable development is evident in the provision that "*development must be socially, environmentally and economically sustainable…. and requires the consideration of all relevant factors…*". NEMA also imposes a duty of care, which places an obligation on any person who has caused, is causing, or is likely to cause damage to the environment to take reasonable steps to prevent such damage. In terms of NEMA's preventative principle, potentially negative impacts on the environment and on people's environmental rights (in terms of the Constitution of the Republic of South Africa, Act No. 108 of 1996) should be anticipated and prevented, and where they cannot be prevented altogether, they must be minimised and remedied in terms of "reasonable measures".

In assessing the environmental feasibility of the proposed construction of the proposed Project, the requirements of all relevant legislation have been considered. The identification and development of appropriate mitigation measures that should be implemented to minimise potentially significant impacts associated with the project, has been informed by best practice principles, past experience, and the relevant legislation (where applicable).

The conclusions of this BA are the result of comprehensive assessments. These assessments were based on issues identified through the BA process and public participation undertaken to date. The BAR will be subject to public review, which was undertaken according to the requirements of NEMA with every effort made to include representatives of all stakeholders within the process. The BAR will be updated and finalised taking into consideration all comments received during the public review period before being submitted to the CA for consideration.

9.1 ENVIRONMENTAL SENSITIVITIES

The following environmental sensitivities were identified on the site, as a result of the Project location and proposed activities and will require specific applications or measures for mitigation to minimise impact.

- **Freshwater:**
  - Aquatic CBAs
  - Wetland features
  - Freshwater ecosystem priority areas
- **Biodiversity:**
  - CBA and ESA
  - Critically endangered and endangered species
- **Avifauna:**
  - High value habitat unit
  - Presence of sensitive species
- **Visual:**
  - Visual receptors
- **Heritage**
  - Heritage resources within study area
- **Palaeontology:**
  - Features with very high paleontological sensitivity
- **Agriculture**
  - Annual crop cultivation

- Planted pasture rotation

The above sensitivities are discussed in the sub-sections below. The combined environmental sensitivities of the proposed powerline Project footprint are shown in **Figure 9-1**.

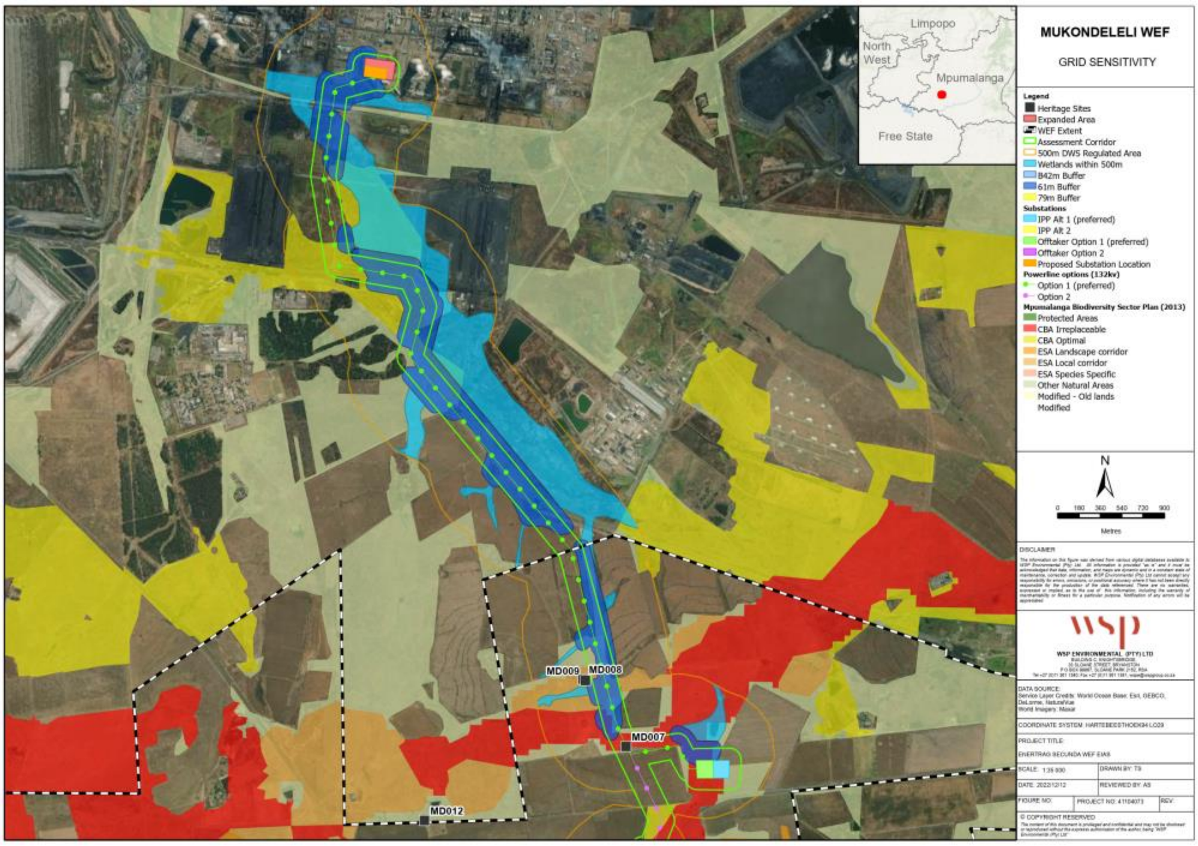
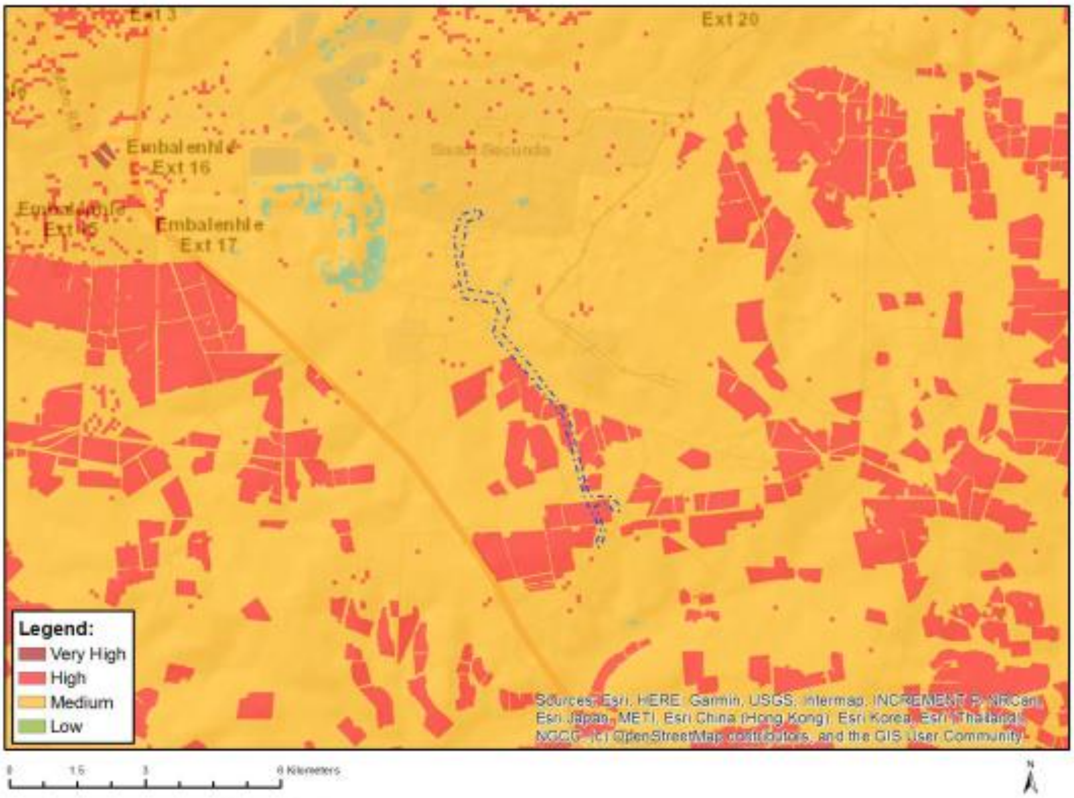


Figure 9-1: Combined Sensitivity Map for the Mukondeleli Gridline

9.1.1 AGRICULTURAL SENSITIVITY

Based on the DFFE Screening Tool the Mukondeleli powerline corridor is classified as Very High Sensitivity with regards to the agricultural theme (**Figure 9-2**).

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;09. Moderate-High/10. Moderate-High
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate

Figure 9-2: DFFE Screening Tool outcome agricultural theme sensitivity

Agricultural sensitivity is a direct function of the capability of the land for agricultural production. All arable land that can support viable crop production, is classified as high (or very high) sensitivity. This is because there is a scarcity of arable production land in South Africa and its conservation for agricultural use is therefore a priority. Land which cannot support viable crop production is much less of a priority to conserve for agricultural use, and is rated as medium or low agricultural sensitivity.

It is important to recognise that the agricultural sensitivity of land, in terms of a particular development, is not only a function of the screening tool sensitivity, but is also a function of the severity of the impact which that development poses to agriculture. This is not recognised in the screening tool classification of sensitivity. So, for example, the sensitivity of an agricultural environment to overhead powerlines is not what the screening tool classifies the sensitivity as, because most agricultural environments have a very low sensitivity to overhead powerlines. This is because powerlines have negligible agricultural impact in most environments, regardless of the agricultural production potential of the land that they cross (see Section 9). Therefore, in the context of the development of overhead powerlines, almost no land can be considered to have high sensitivity for impacts on agricultural resources. For this reason the screening tool sensitivity of the powerline corridor is largely irrelevant. In this assessment, only the footprint of the substation is of relevance.

The screening tool classifies agricultural sensitivity according to only two independent criteria – the land capability rating and whether the land is used for cropland or not. All cropland is classified as at least high sensitivity, based on the logic that if it is under crop production, it is indeed suitable for it, irrespective of its land capability rating.

The screening tool sensitivity categories in terms of land capability are based upon the Department of Agriculture's updated and refined, country-wide land capability mapping, released in 2016. The data is generated by GIS modelling. Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rain fed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land, based on its soil, climate and terrain. The higher land capability values (≥8 to 15) are likely to be suitable as arable land for crop production, while lower values are only likely to be suitable as non-arable grazing land.

A map of the proposed powerline and substations alternatives, overlaid on the screening tool sensitivity, is given in **Figure 9-2**, but as noted above, the screening tool sensitivity of the powerline corridor is largely irrelevant to agricultural impact. The only relevance is that pylons should be located outside of or on the edges of cropland, where possible, so that they minimise interference with crop production.

9.1.2 AQUATIC ECOLOGY

Based on the National Web-Based Environmental Screening tool classifies parts of the study area as very high sensitivity due to the presence of wetlands and estuaries (**Figure 9-3**).

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Wetlands and Estuaries

Figure 9-3: The DFFE screening tool rating for the Aquatic Biodiversity Theme

In terms of the desktop assessment the study site has conservation significance both in terms of national as well as provincial conservation planning. The site verification assessment indicated that the proposed layout encroaches on the wetlands and their associated buffer areas.

The desktop assessment conducted by DWS indicated that the sub quaternary reaches surrounding the study site are largely natural (B) to moderately modified (C). The site verification indicated that the wetlands are moderately (C) to seriously modified (E) whilst the aquatic macroinvertebrates indicated that the aquatic ecosystems are seriously/critically (E/F) modified. Therefore, the wetland and aquatic ecosystems surrounding the study site do not conform to the desktop assessment and are more impacted than expected (Figure 9-4).

Based on the field assessments, the wetland delineation and buffer indicate that the current layout encroaches on the wetlands as well as their respective buffer areas. Although the wetland and aquatic ecosystems are impacted, they still fulfil important ecosystem services and also form part of national and provincial conservation targets.

Ideally a walk down should be done on site once the location of each pylon is available to ensure the footprints remain outside of watercourses as far as possible.

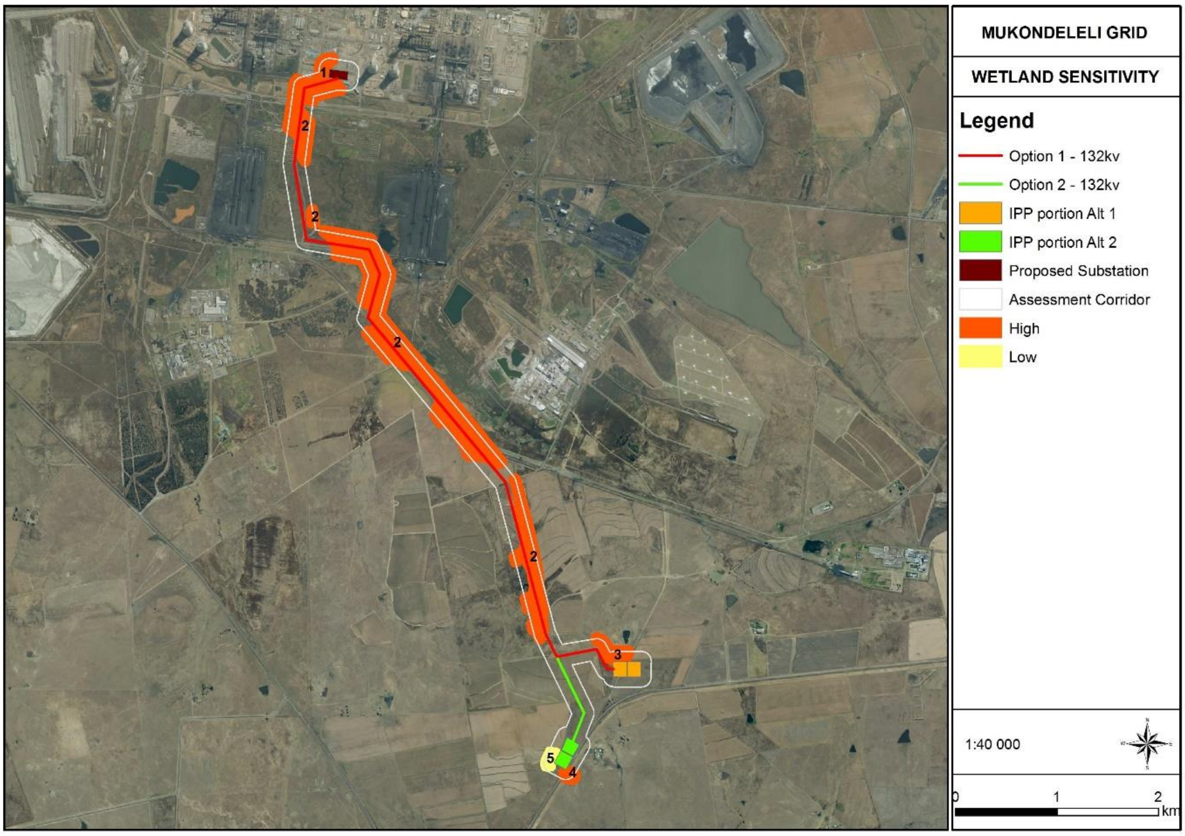


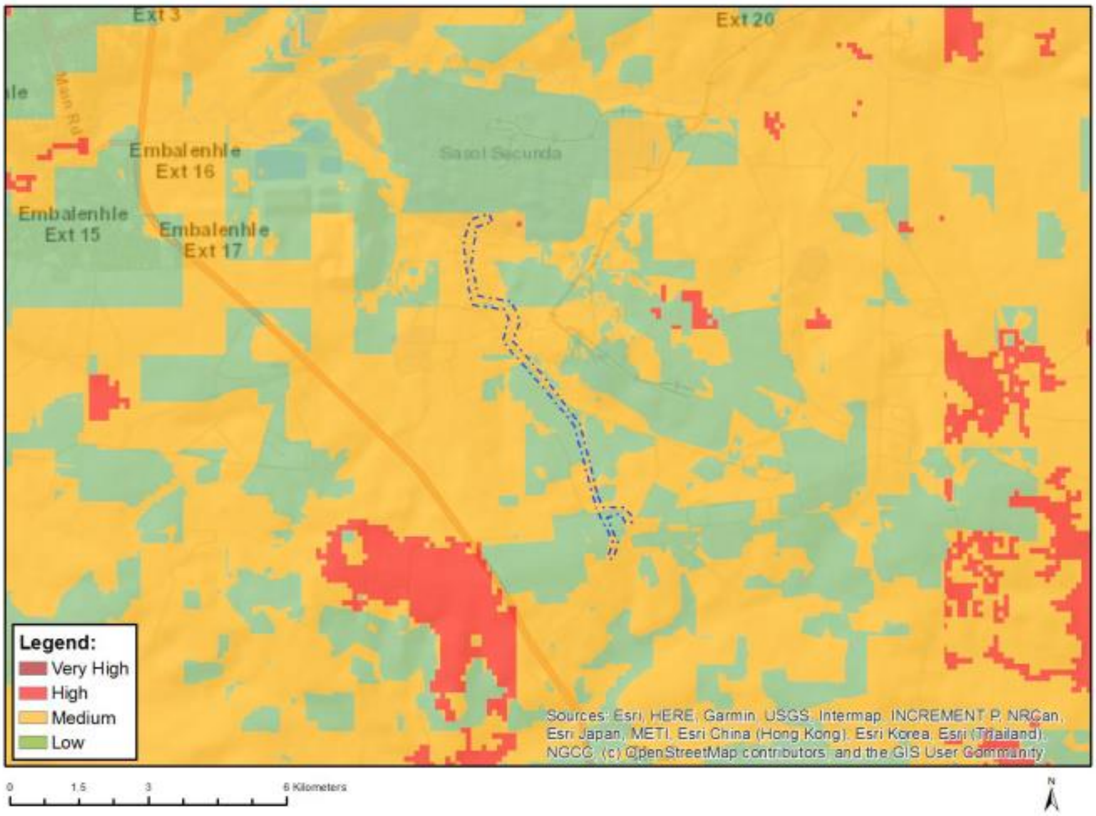
Figure 9-4: Wetland sensitivity based on the Site Ecological Importance (SANBI, 2020) for the proposed Mukondeleli gridline

9.1.3 TERRESTRIAL ECOLOGY

ANIMAL SPECIES THEME

The animal species theme sensitivity, as indicated in the Screening Report of the National Web based Environmental Screening Tool, was derived to be Medium sensitivity, mainly due to the occurrence of three species with an IUCN status of Vulnerable as being of concern such as *Aves-Sagittarius serpentarius*, *Insecta-Lepidochrysops procera* and *Mammalia-Crocidura maquassiensis* (**Figure 9-5**).

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Subject to confirmation
Medium	Aves-Sagittarius serpentarius
Medium	Insecta-Lepidochrysops procera
Medium	Mammalia-Crocidura maquassiensis

Figure 9-5: Animal Species Theme Sensitivity, DEA Screening Report

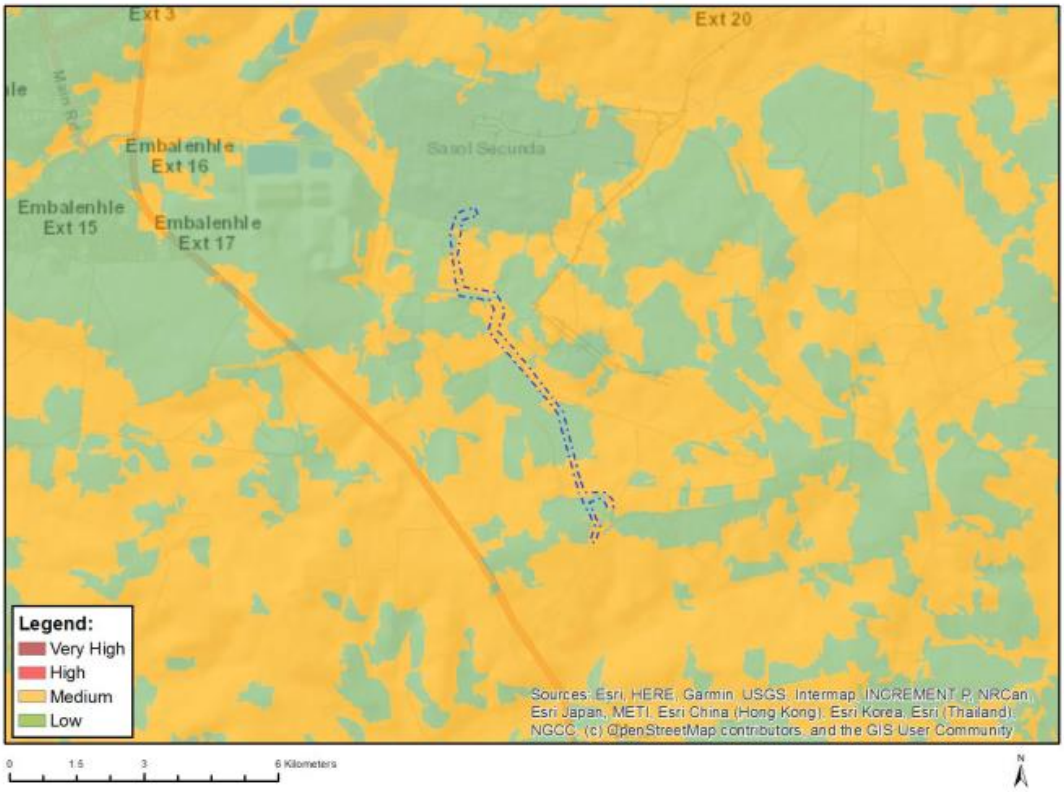
The Screening Tool listed *Lepidochrysops procera* (Lepidoptera) as a SCC for the site. However, it was not listed in the ADU database, the MNCA (1998) provincial species lists or the NEMBA (2007c) ToPS lists. *Lepidochrysops procera* was not recorded on site and is unlikely to occur there because its host plant (*Ocimum obovatum*) was not present on site.

- The Maquassie Musk Shrew *Crocidura maquassiensis* was not listed in the ADU mammal species list or the MNCA (1998) lists for the Mpumalanga province and was not recorded on site during the survey. The Maquassie Musk Shrew depends on wetlands as suitable habitat in savanna and grasslands. Although it has a wide inferred extent of occurrence, it appears to be patchily distributed. *Crocidura maquassiensis* has not been reported from Mpumalanga Province post-1999 and thus there is a very low probability for it to occur on site.
- What the screening tool did not highlight was the possible presence of the Giant girdled lizard, a species with a Vulnerable IUCN status. The species has been reported by one of the landowners on the Mukondeleli WEF site.
- Overall sensitivity of animal theme (avifaunal and bat components excluded) is thus rated as medium. However, if the suggested mitigation measures are followed the animal SCC should not be negatively affected.

PLANT SPECIES THEME

The plant species theme sensitivity, as indicated in the Screening Report of the National Web based Environmental Screening Tool, was derived to be Medium sensitivity, mainly due to the occurrence of Sensitive species 1251 and 691 (**Figure 9-6**).

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Sensitive species 1252
Medium	Sensitive species 691

Figure 9-6: Plant Species Theme Sensitivity, DEA Screening Report

The Screening Tool rated the sensitivity of the Plant Species Theme as medium and three species were highlighted as being of concern. None of the SCC highlighted by the screening tool were recorded on site and the site verification indicated that most of the site had a low sensitivity.

- Sensitive species 691 occurs in damp depressions in shallow soil over rock sheets. This type of habitat is not present along the gridline.
- The habitats on site do not present suitable habitat for sensitive species 1252 because of a lack of wooded habitat.
- The third plant species of concern, *Pachycarpus suaveolens*, prefers grassland, but was not recorded during the site survey. It occurs in areas that are currently extensively transformed by urban development, crop

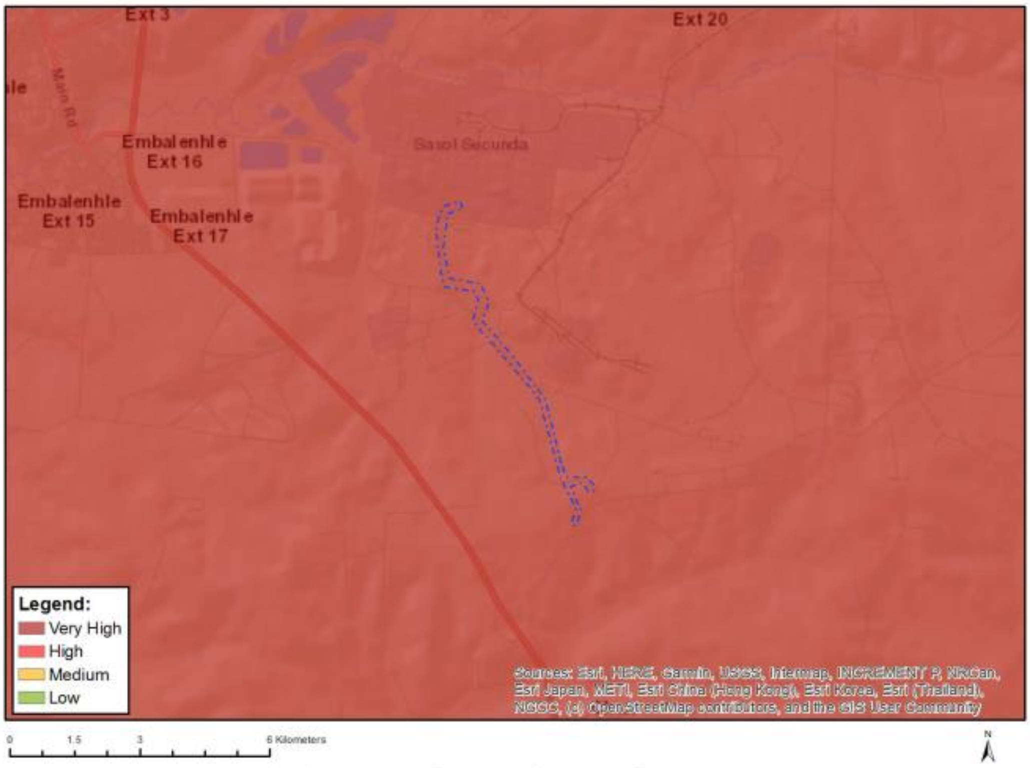
cultivation, mining and invasive alien plants. Its distribution records show it to be more common northwards from the Secunda sites, e.g. in the Witbank- Carolina area.

— A low sensitivity rating is recommended for the Plant Species Theme

TERRESTRIAL BIODIVERSITY THEME

The biodiversity theme sensitivity, as indicated in the Screening Report of the National Web based Environmental Screening Tool, was derived to be Very High sensitivity, mainly due to the presence of a Vulnerable ecosystem, CBAs, ESAs and Protected Area Expansion Strategy (NPAES). River or wetland FEPAs were not flagged by the screening tool as reasons for the very high sensitivity. (**Figure 9-7**).

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Critical biodiveristy area 1
Very High	Critical biodiveristy area 2
Very High	Ecological support area: local corridor
Very High	Protected Areas Expansion Strategy
Very High	Vulnerable ecosystem

Figure 9-7: Terrestrial Biodiversity Theme Sensitivity, DEA Screening Report

This theme considers the presence of protected areas, NPAES, CBAs, ESAs and NFEPAs.

- The study area is not located in a protected area nor does it fall in an area earmarked for the NPAES (NPAES 2010). It is also not earmarked for expansion in the 5-year plan of the Mpumalanga PAES.
- Our background study confirms that the Soweto Highveld Grassland vegetation type on site is listed as 'Vulnerable'.
- Our background study indicated that although there are CBAs present on site, our sensitivity analysis rated most of these areas as being of low sensitivity. Nevertheless, the gridline should preferably not be located within the area demarcated as CBA.
- There are ESA Landscape corridors and ESA Local corridors indicated on site (Figure 15), but the presence of the gridline would not impact negatively on them.
- FEPAs or water catchments were not flagged by the screening tool. Based on the site assessment of the vegetation most of the area mapped as upstream river FEPA was rated as having a low or medium sensitivity, with only the drainage lines having a high sensitivity. Several Highveld wetland are present on site (see aquatic specialist report), but these were also not highlighted by the Screening Tool.

Unfortunately, the screening tool on site limits the sensitivity outcome of the Relative Terrestrial Biodiversity Theme to either very high or low. This is an issue which should be revisited by DFFE since it does not give a proper representation of the site conditions. Although we agree with the presence of the CBA, the entire site does not qualify as CBA, since a large proportion of the site is degraded and under cropland or abandoned cropland. Thus if the same 4-tiered scale were to be applied to this theme, as in the case of the other themes, we would rate it as **medium to low**.

ECOLOGICAL SENSITIVITY

Sensitivity is the vulnerability of a plant community or habitat to an impact, for example a wetland or ridge system would be more vulnerable to development than would a sandy plain. Several features of a site can be assessed to derive a sensitivity score, such as:

- Threatened status of the regional vegetation types wherein the proposed site is situated.
- Percentage of IUCN threatened (red-listed) plant species per habitat.
- Number of protected tree species per habitat.
- Percentage of provincially protected plant species per habitat.
- Presence of endemic plant species per habitat or site (endemic to vegetation type).
- Conservation value of plant community (habitat).
- Species richness per habitat or per sample plot (number of plant species).
- Degree of connectivity and/or fragmentation of the habitat, i.e. high connectivity and low fragmentation infers a low rating.
- Soil erosion potential.
- Resilience (this is a measure of the ability of a particular habitat to recover after an impact, i.e. high resilience infers low rating)

Overall, the drainage lines (including dams) (Habitat 7 – high sensitivity) were more sensitive than the other habitats on site. Habitats 1, 2 & 3 did not occur on the Mukondeleli gridline sites. Habitats 8, 9 & 10 are man-made habitats with a low sensitivity rating, e.g. cropland, planted pasture, plantations, wind breaks and diggings.

Pylon positioning should avoid the high sensitivity drainage lines (Habitat 7). The on-site substations currently seems to be located in a CBA1, although the sensitivity of the site was rated as low in the current assessment.

Along the water courses, buffers are applicable to the development. A buffer zone of 32 m is usually applied to drainage lines, but the aquatic specialists may apply wider buffer zones along these habitats. No buffer has been applied in **Figure 9-8**, since it is advised to follow the recommendations of the aquatic specialist in this regard.

Apart from the drainage lines, with high sensitivity, the CBAs did not emerge as being highly sensitive in the sensitivity model that was applied. The areas mapped as FEPAs were largely incorporated into the CBAs and likewise did not emerge as being highly sensitive in the sensitivity model that was applied.

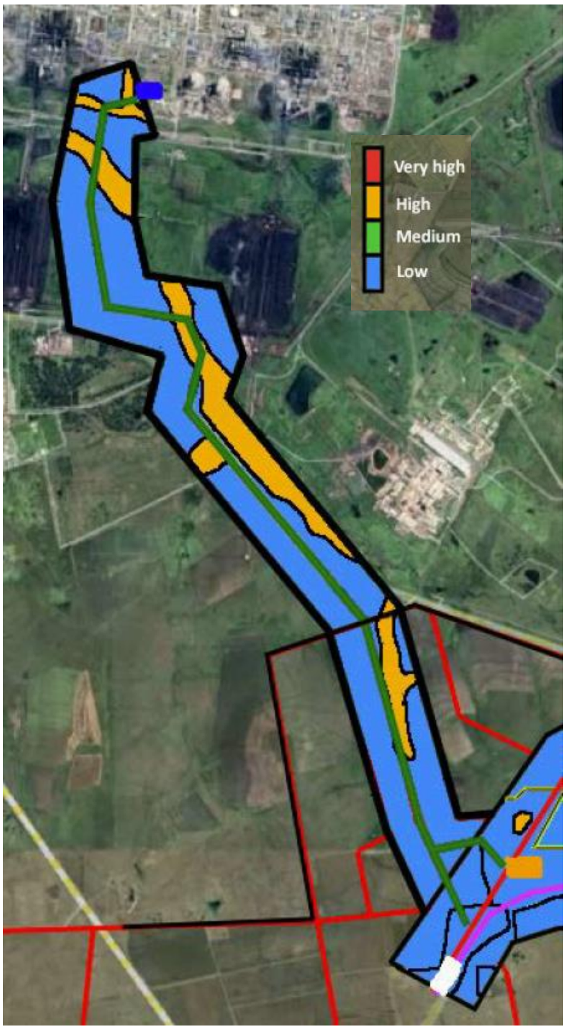


Figure 9-8: Sensitivity map of the Mukondeleli gridline site

9.1.4 AVIFAUNAL SENSITIVITIES

The project site is classified as **Low, Medium and High Sensitivity** for terrestrial animals according to the Terrestrial Animal Species Theme[12].

The high sensitivity classification is linked to the potential occurrence of Caspian Tern (Globally Least Concern, Regionally Vulnerable). The Medium sensitivity is linked to African Marsh Harrier (Globally Least Concern, Regionally Endangered), Caspian Tern (Globally Least Concern, Regionally Vulnerable), White-bellied Bustard (Globally Least Concern, Regionally Vulnerable), Secretarybird (Globally Endangered, Regionally Vulnerable) and African Grass Owl (Globally Least Concern, Regionally Vulnerable) (**Figure 9-9**).

The project site contains confirmed habitat for these species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020), namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered, Vulnerable, Near Threatened, and Data Deficient species.

[12] The Avifauna Wind Theme is only relevant to developments in Renewable Energy Development Zones (REDZ). The Terrestrial Animal Species Theme must be used for those developments located outside of REDZ.

The occurrence of Secretarybird (Globally Endangered, Regionally Vulnerable) and additional SCC was confirmed during the surveys i.e., Black-winged Pratincole (Globally Near Threatened, Regionally, Near Threatened), Blue Crane (Globally, Vulnerable, Regionally Near Threatened), Blue Korhaan (Globally, Vulnerable, Regionally Least Concern), Greater Flamingo (Globally Least Concern, Regionally Near Threatened), and Lanner Falcon (Globally Least Concern, Regionally Vulnerable) were recorded in the project site.

In summary, based on the Site Sensitivity Verification field surveys conducted, habitat within the PAOI is suitable for Black-winged Pratincole, Blue Crane, Blue Korhaan, Greater Flamingo, Lanner Falcon, and Secretarybird. Therefore, a classification of **High Sensitivity** for avifauna tool for the Terrestrial Animal Species theme is suggested for the project site.

The following specific environmental sensitivities were identified from an avifaunal perspective:

Drainage lines, dams, pans and associated wetlands. These habitat features are important attractions for many powerline sensitive species, particularly waterbirds, including Red List species such as Blue Crane and Maccoa Duck. Birds commuting between these areas will be at risk of collision with the earthwire if they have to cross over the grid connection. Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

Natural grassland. The natural grassland is vital breeding, roosting and foraging habitat for a variety of Red List powerline sensitive species and will therefore be associated with significant flight activity. These include Secretarybird, Blue Korhaan, Pallid Harrier, Red-footed Falcon and Blue Crane. Spans crossing these areas, or situated between two or more such areas, must be identified during the walk-through inspection once the final tower positions have been determined and marked with Bird Flight Diverters.

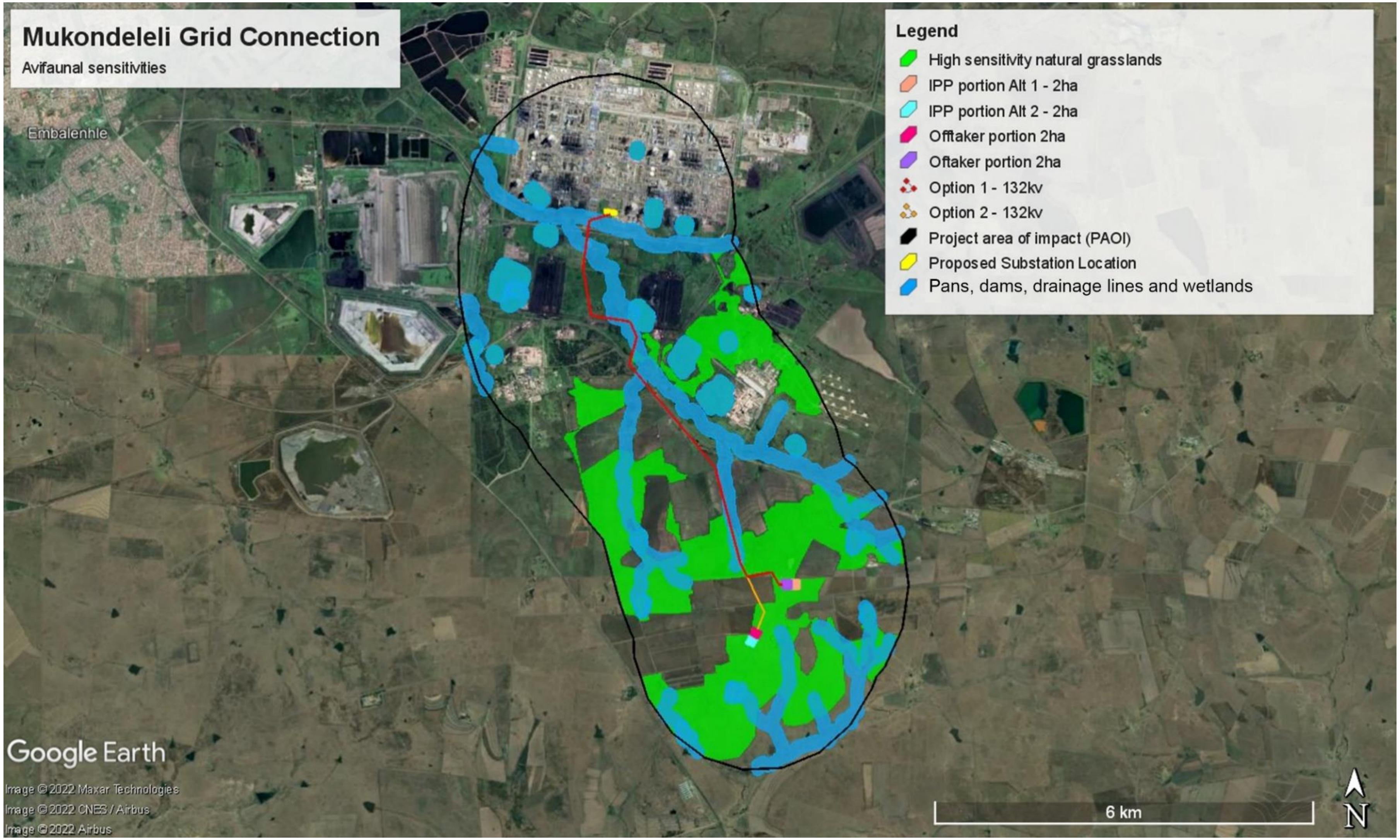


Figure 9-9: Avifaunal sensitivities within the Mukondeleli Grid Connection project area of impact.

9.1.5 VISUAL SENSITIVITY

In assessing visual sensitivity, the proposed development was examined in relation to the Landscape Theme of the National Environmental Screening Tool to determine the relative landscape sensitivity for the development of grid connection infrastructure. The tool does not however identify any landscape sensitivities in respect of the proposed powerline.

OUTCOME OF THE SPECIALIST SENSITIVITY ANALYSIS AND VERIFICATION

Visual sensitivity can be defined as the inherent sensitivity of an area to potential visual impacts associated with a proposed development. It is based on the physical characteristics of the area (i.e., topography, landform and land cover), the spatial distribution of potential receptors, and the likely value judgements of these receptors towards a new development (Oberholzer: 2005). A viewer's perception is usually based on the perceived aesthetic appeal of an area and on the presence of economic activities (such as recreational or nature-based tourism) which may be based on this aesthetic appeal.

In order to assess the visual sensitivity of the receiving environment, a matrix has been developed based on the characteristics of the receiving environment which, according to the Guidelines for Involving Visual and Aesthetic Specialists in the EIA Processes, indicate that visibility and aesthetics are likely to be 'key issues' (Oberholzer: 2005).

Based on the criteria in the matrix (**Table 9-1**), the visual sensitivity of the area is broken up into a number of categories, as described below:

- **High -** The introduction of a new development such as a powerline is likely to be perceived negatively by receptors in this area; it would be considered to be a visual intrusion and may elicit opposition from these receptors.
- **Moderate** – Receptors are present, but due to the nature of the existing visual character of the area and likely value judgements of receptors, there would be limited negative perception towards the new development as a source of visual impact.
- **Low -** The introduction of a new development would not be perceived to be negative, there would be little opposition or negative perception towards it.

Table 9-1 outlines the factors used to rate the visual sensitivity of the study area. The ratings are specific to the visual context of the receiving environment within the study area.

Table 9-1: Environmental factors used to define visual sensitivity of the study area

FACTORS	DESCRIPTION	RATING 1	2	3	4	5	6	7	8	9	10
Pristine / natural / scenic character of the environment	Study area is largely pastoral with some areas of scenic value, although some areas are significantly transformed.										
Presence of sensitive visual receptors	No sensitive receptors have been identified in the study area, although *potentially* sensitive receptors are present.										
Aesthetic sense of place / visual character	Visual character is a typical rural / pastoral landscape, although significantly transformed by urban / industrial development and mining activity.										
Irreplaceability / uniqueness / scarcity value	Few areas of scenic value were found within the study area.										
Cultural or symbolic meaning	Much of the area is a typical rural / pastoral landscape.										
Protected / conservation areas in the study area	No protected or conservation areas were identified in the study area.										
Sites of special interest present in the study area	No sites of special interest were identified in the study area.										
Economic dependency on scenic quality	No tourism/leisure-based facilities were found in the area										
International / regional / local status of the environment	Study area is typical of rural / pastoral landscapes, although significantly transformed by urban / industrial development and mining activity.										
**Scenic quality under threat / at risk of change	Introduction of new powerlines will alter the visual character and sense of place, giving rise to significant cumulative impacts										

**Any rating above '5' for this specific aspect will trigger the need to undertake an assessment of cumulative visual impacts.

Low			Moderate				High		
10	20	30	40	50	60	70	80	90	100

Based on the above factors, the total score for the study area is 28, which according to the scale above, would result in the area being rated as having a **LOW** visual sensitivity. It should be stressed however that the concept of visual sensitivity has been utilised indicatively to provide a broad-scale indication of whether the landscape is likely to be sensitive to visual impacts and is based on the physical characteristics of the study area, economic activities and land use that predominates. An important factor contributing to the visual sensitivity of an area is the presence, or absence of visual receptors that may value the aesthetic quality of the landscape and depend on it to produce revenue and create jobs and this has been factored into the sensitivity rating above. The presence of visual receptors is examined in more detail in **Section 6.3.3** of this report. However, no formal protected areas, leisure-based tourism activities or sensitive receptor locations were identified in the study area.

As part of the visual sensitivity assessment, a screening exercise was undertaken with the aim of indicating any areas that should be precluded from the proposed development footprint. From a visual perspective, these are areas where the establishment of powerlines would result in the greatest probability of visual impacts on any sensitive or potentially sensitive visual receptors.

Using GIS-based visibility analysis, it was possible to determine which sectors of the combined assessment corridor would be visible to the highest numbers of receptors in the study area. This analysis confirmed that areas of higher elevation are visible to greater numbers of potentially sensitive receptors. Hence the visual prominence of a tall structure such as a powerline tower would be exacerbated if located on any ridges or a relatively higher-lying plateaus. It is noted that a small section of the proposed powerline route alignment traverses an area of relatively higher elevation that could be seen as an area of potentially high visual sensitivity. **However, due to the relatively low number of potentially sensitive receptors in the area, the presence of existing powerlines and road infrastructure as well as the fact that the study area as a whole is rated as having a low visual sensitivity, the sensitivity rating of this area would be reduced to "Medium".**

In determining visual sensitivity, consideration must be given to the direct visual impact of the powerlines on any farmsteads or receptors located in, or within 500m of, the combined assessment corridor. Only one (1) receptor was found to be within 500m of the combined assessment corridor, this being VR75 and as such a 500m zone of potential visual sensitivity has been delineated around this farmstead. However, as this receptor is located within the Mukondeleli WEF project area, it is assumed that the owner of this property is involved in the development and is unlikely to view the proposed EGI in a negative light. Hence this zone, as shown in **Figure 9-10**, is not considered to be a "no go area", but rather should be viewed as a zone of potential visual sensitivity.

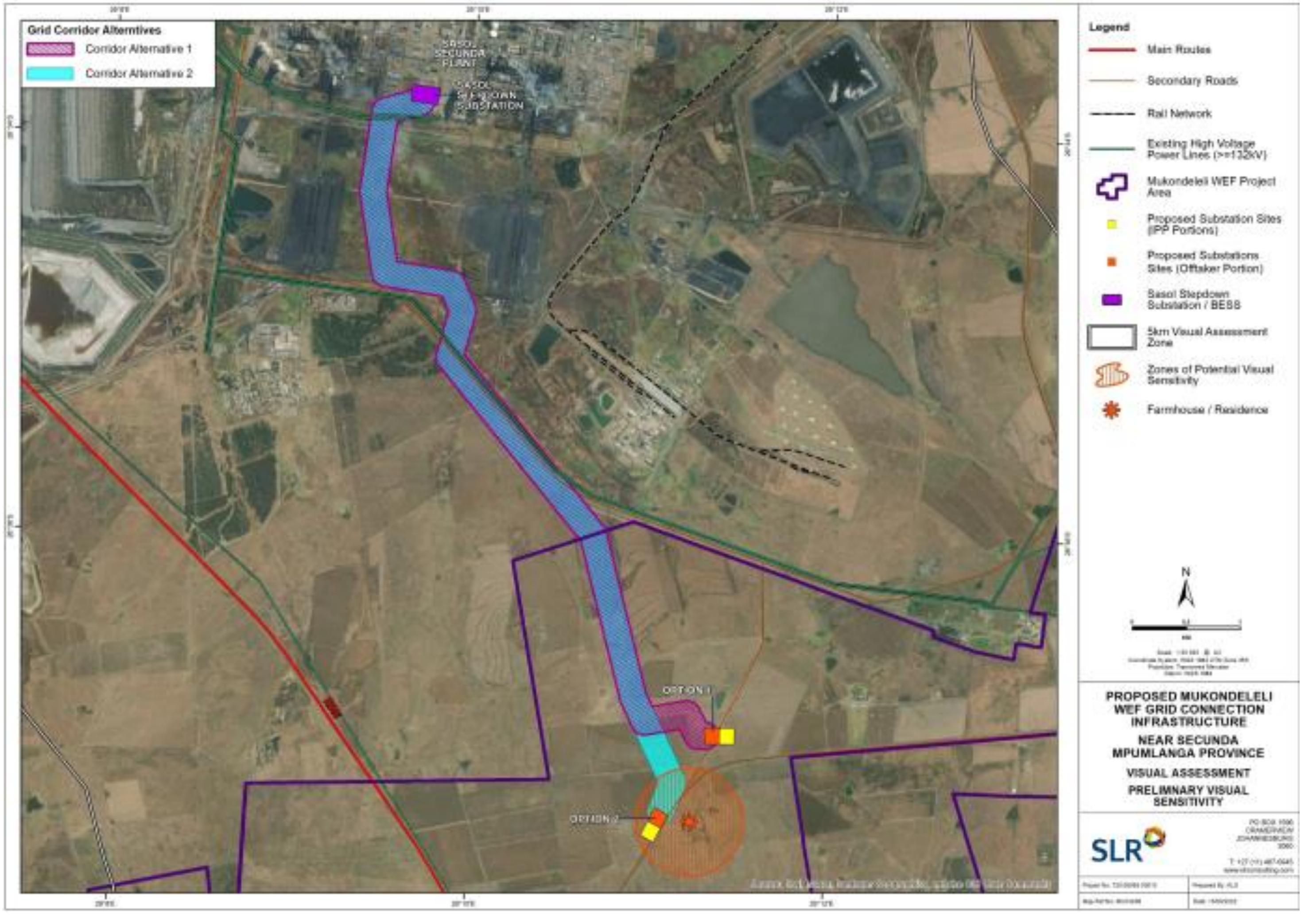
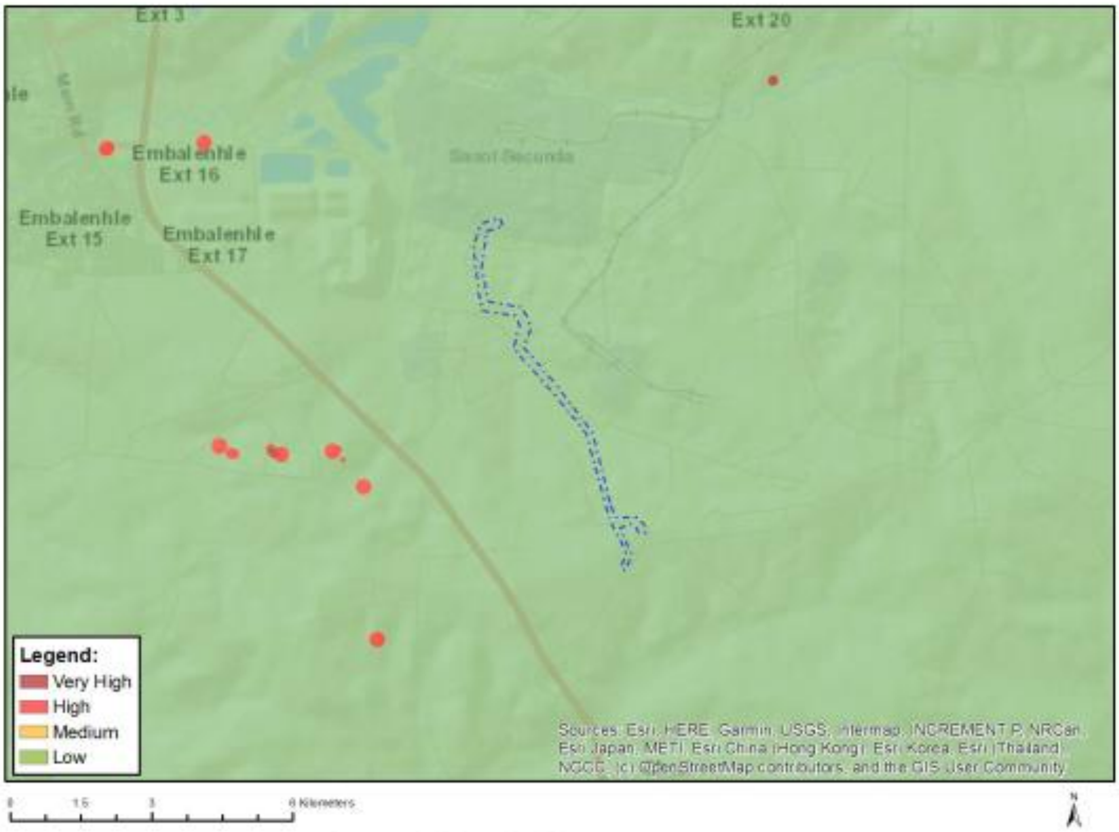


Figure 9-10: Visual Sensitivity on the Mukondeleli EGI Assessment Corridor

9.1.6 HERITAGE SENSITIVITY

Based on the DFFE Screening Tool the Mukondeleli powerline corridor is classified as Low sensitivity with regards to the archaeological and cultural heritage theme, with the exception of one pocket (where an archaeological resource of medium cultural significance was found) considered to be of high sensitivity (**Figure 9-11**).

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

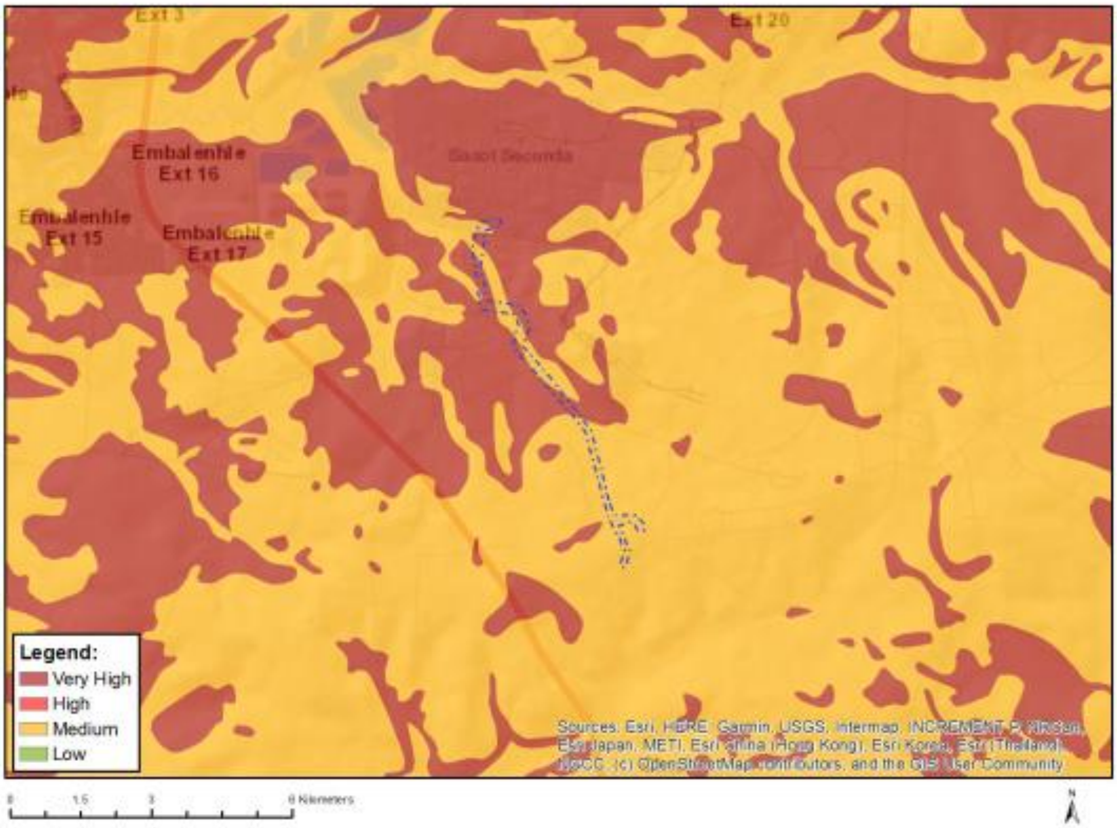
Sensitivity	Feature(s)
Low	Low sensitivity

Figure 9-11: DFFE Screening Tool outcome archaeological and cultural heritage theme sensitivity

9.1.7 PALAEONTOLOGY SENSITIVITY

Based on the DFFE Screening Tool the Mukondeleli powerline corridor is classified as Very High Sensitivity with regards to the palaeontology theme, due to the occurrence of features with Very High Palaeontological sensitivity (**Figure 9-12**).

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity
Very High	Features with a Very High paleontological sensitivity

Figure 9-12: DFFE Screening Tool outcome palaeontology theme sensitivity

9.2 SPECIALIST CONCLUSIONS

9.2.1 AGRICULTURAL ASSESSMENT

The conclusion of this assessment is that the proposed development will have low agricultural impact and will therefore be acceptable in terms of its impact on the agricultural production capability of the site. The only impact of this development is the loss of approximately 2 hectares of agricultural land on the site of the substation. This is assessed as being of low significance because the amount of land loss is very small and the production potential of the land is limited to being unsuitable for crop production and only suitable as grazing land.

The powerline itself has insignificant agricultural impact because all agricultural activities that are viable in this environment, can continue completely unhindered underneath the powerline and there will therefore be negligible loss of agricultural production potential underneath it.

The only potential source of impact from the powerline is minimal disturbance to the land (erosion and topsoil loss) during construction (and decommissioning). This impact can be completely mitigated with standard, generic mitigation measures that are included in the DFFE Generic EMPr.

From an agricultural impact point of view, it is recommended that the development be approved.

Because of the insignificant agricultural impact of the powerline, there can be no material difference between the agricultural impacts of any of the alternative powerline routes. All proposed route alternatives are considered equally acceptable in terms of agricultural impact. In terms of the substation site, both alternatives are considered equally acceptable in terms of agricultural impact.

The conclusion of this assessment on the acceptability of the proposed development and the recommendation for its approval is only subject to the condition that the pylon locations minimize agricultural impacts by being located, wherever possible, outside of or on the edges of cropland so that they interfere minimally with crop production. Pylon locations should be assessed and approved by an agricultural specialist during the final micro-siting walk-through exercise that occurs after Environmental Authorisation and prior to construction. A desktop assessment of the pylon positions using satellite imagery will be adequate for this purpose.

9.2.2 AQUATIC ASSESSMENT

The desktop assessment indicated that the study site is situated in an area which has conservation significance in both national as well as provincial level.

A large number of wetlands were recorded on the study site. The wetlands were divided into several types including:

— Seepage wetlands;
— Valley Bottom Wetlands; and
— Depressional Pan wetlands.

The wetlands fall into three distinct catchment areas, with wetland 1-3, all located in catchment C12D and all draining into Groot-Bessiespruit River. Furthermore, wetland 4 & 5 drain into the Boesmanspruit River..

Buffer zones were calculated for the wetlands following Macfarlane *et al.*, (2015):

— Floodplain Wetland – 61 m
— Floodplain Wetland – 61 m
— Seepage Wetland – 61 m
— Valley Bottom Wetlands – 79m
— Seepage with Artificial Characteristics historical trenches – 42 m

The desktop assessment conducted by DWS indicated that the sub quaternary reaches surrounding the study site are largely natural (B) to moderately modified (C). The site verification indicated that the wetlands are moderately (C) to seriously modified (E) whilst the aquatic macroinvertebrates indicated that the aquatic ecosystems are seriously/critically (E/F) modified. Therefore, the wetland and aquatic ecosystems surrounding the study site do not conform to the desktop assessment and are more impacted than expected.

Two potential route options as well as two IPP portion substation Alternatives in the south were investigated as well as one Substation in the north. The two routes follow the same route from the northern substation predominantly adjacent to Sasol access roads in a southern direction were the routes diverge to the two alternative IPP portions. Surface water from both the alternative IPP portions (Substations) have increased significantly and are now wetter compared to images circa 1955. This indicates large impacts from the adjacent Sasol complex and other sources. Both substation options are located on areas not previously used for agriculture, however Substation Option two is located directly adjacent to an existing road and development here will have less impact compared to Substation Option 1 and is therefore suggested. The route options are similar and only differ at the end points near the proposed substations and Route Option 2 is thus the preferred option. However, due to both being in close proximity to wetlands and within the 500 m DWS regulated areas, the options should be weighed against the other specialist findings.

Prior to the proposed mitigation measures most impacts rated moderate and post mitigation they ranked low in both the construction and operational phase. Cumulative impacts include the impacts of the proposed Mukondeleli WEF and Vhuhili SEF in combination with the other projects within a 50 km radius. Similarly, if the wetlands and buffer zones are excluded, where possible from the proposed Mukondeleli grid routings (subject to separate applications) as well, the impacts should be reduced significantly.

9.2.3 TERRESTRIAL ECOLOGY ASSESSMENT

Provided the positioning of gridline infrastructure takes sensitive habitats, i.e. drainage lines and wetlands and CBAs into consideration, the resulting low sensitivity rating and low impact significance for many of the habitats means the project could go ahead, provided all mitigation measures and management actions proposed to conserve protected fauna and flora on the site, are taken into consideration. We thus recommend authorisation of the project provided all mitigation measures are implemented.

A brief summary of the most important considerations is provided below:

- Vegetation and flora:
  - Vegetation types: The Soweto Highveld Grassland vegetation type is listed as “Vulnerable” and consequently the gridline infrastructure should give preference to the habitats on site where past disturbance has occurred e.g. disturbed areas, cultivated cropland or abandoned cropland (old lands). • Screening Tool: The species that were highlighted by the Screening tool were not encountered on site.
  - Threatened plant species: No IUCN threatened or red-listed plant species were encountered during the field survey.
  - Protected plant species: No ToPS species or protected tree species were recorded on site. A number of Mpumalanga protected species were recorded on site, but none with a threatened IUCN status.
  - CITES: Aloe ecklonis, *Aloe transvaalensis* and *Euphorbia clavarioides* were the CITES species recorded on the Mukondeleli WEF site.
  - Habitats: Three of the four habitats on site had a low sensitivity rating, while the wetland habitat (Habitat 7, including dams) had a high sensitivity rating. All other habitats (mostly man-made) had a low sensitivity rating.
  - Overall sensitivity of plant theme based on the status of the habitats (plant communities): Rated as low, provided some infrastructure is repositioned to avoid CBAs, drainage lines and wetlands. The Soweto Highveld Grassland has a Vulnerable threat status and to minimise the impact on the vegetation a ground cover should be maintained in the servitude along the gridline.
- Fauna (avifaunal and bat components excluded):
  - Screening Tool: The species that were highlighted by the Screening tool, viz. the Maquassie musk shrew (*Crocidura maquassiensis*) and *Lepidochrysops procera* were not encountered on site and are not listed on the ADU database for the region or the MNCA (1998) provincial species lists.
  - Threatened animal species: The giant girdled lizard (Smaug giganteus), a reptile with a Vulnerable IUCN status, has been noted on Mukondeleli according to one of the landowners. As a precautionary

measure, it is recommended that a survey should be done for this reptile once the proposed final layout has been established. This species was however not highlighted by the Screening Tool.

  - Near Threatened species: Three Near Threatened mammal species are reported for the region, according to the landowners in the vicinity of the gridline, i.e. the serval (Leptailurus serval), Southern African hedgehog (Atelerix frontalis) and Southern African vlei rat Otomys auratus. None of these species were however highlighted by the Screening Tool.
  - Overall sensitivity of animal theme (avifaunal and bat components excluded): This is rated as medium. If the suggested mitigation measures are followed the animal SCC should not be negatively affected.
- Conservation:
  - Protected Areas: The study area is not located in a protected area.
  - National Protected Areas Expansion Strategy (NPAES): The development will not interfere with the protected areas expansion strategy according to the NPAES spatial data of 2010 and it is also not earmarked in the 5-year plan of the Mpumalanga PAES (data supplied by M. Lötter, MTPA).
  - CBAs: According to the current layout, the gridline crosses some CBAs, however pylon positions can be selected to avoid drainage lines. The on-site substation is currently located in the CBA area, however the particular site was classified as having a low sensitivity in the current assessment.
  - ESAs: There are ESAs (Landscape and Local corridors) distinguished along the gridline route. However, the development would not impact negatively on these units.
  - FEPA: Although the entire site is classified as an upstream management area, the site assessment of the vegetation and the application of a sensitivity model rated most of the river FEPA area as being of low to medium sensitivity, with only the drainage lines having a high sensitivity.
  - Mpumalanga Highveld wetlands: These wetlands were largely incorporated into the delineation of the CBAs (refer to aquatic specialist report for wetlands).
- Ecological processes, function and drivers:
  - Overall, it is unlikely that the development will contribute to the disruption of broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions.
  - The disturbance caused by the construction of the infrastructure will inevitably create conditions favourable for invasion by alien species and thus a programme for the early detection as well as control of alien invasive plant species must be implemented.
  - Fire is an important driver of vegetation dynamics in the Grassland Biome and can occur when the fuel load is high. To avoid damage to the infrastructure, fire will have to be suppressed. If the grass layer is regularly mowed/brush cut, it should prevent grasses from becoming moribund in the absence of fire, although regular mowing could affect seed set.
- Significance of environmental impacts:
  - Overall the significance of the environmental impacts was rated as very low to low.
  - Since the development footprint is expected to be relatively small, the loss of habitat within the Soweto Highveld Grassland vegetation type will be fairly small. However, our impact assessment was based on the assumptions (i) only a service track would be cleared and a vegetative groundlayer would be retained beneath the rest of the servitude; and (ii) where the vegetation was destroyed at the pylon sites during construction, that it will be rehabilitated and allowed to recover.
  - From an ecological point of view, large portions of the site have been heavily modified (compare CBA map) and are no longer prime examples of the Soweto Highveld Grassland. If the development is thus primarily contained within the heavily or moderately modified areas it would not affect the status of the vegetation type since these modified area were already considered as lost for the allocation of a vulnerable status of the vegetation type.
  - Habitat 7 was rated as highly sensitive in the current assessment.
  - Most of the habitats traversed by the proposed gridline were rated as having a low sensitivity.
  - None of the species highlighted by the screening tool were encountered on site, thus the impact on populations of threatened or protected species will be negligible if all mitigation measures are applied. Although not mentioned by the screening tool, the giant girdled lizard has been reported by one of the landowners. As a precautionary measure once the footprint has been amended to take all specialist

assessments into consideration, a survey of the footprint could be undertaken to establish the presence/absence of the species.

- Depending on the type of fencing to be erected at some of the infrastructure, the gridline infrastructure will contribute minimally to obstruction of animal movement.

9.2.4 AVIFAUNA ASSESSMENT

The proposed Mukondeleli Grid Connection could have a **high** to **moderate** impact on avifauna which, in most instances, could be reduced to **low** through appropriate mitigation, although some moderate residual impacts will still be present after mitigation.

No fatal flaws were discovered during the onsite investigations. The proposed Grid Connection development is therefore supported, provided the mitigation measures listed in this report are strictly implemented.

9.2.5 VISUAL ASSESSMENT

A visual study was conducted to assess the magnitude and significance of the potential visual impacts associated with the development of the proposed Mukondeleli EGI near Secunda in Mpumalanga Province. The VIA has demonstrated that the study area has a somewhat mixed visual character, transitioning from the heavily transformed urban / peri-urban landscape associated with the EMbalenhle and Secunda urban areas and the Sasol Secunda fuel plant in the north and the town of Charl Cilliers in the south to a more rural / pastoral character across the remainder of the study area. Hence, although EGI development would alter the visual character and contrast with this rural / pastoral character, the location of the proposed EGI in relatively close proximity to these transformed areas as well as the associated extensive powerline network will significantly reduce the level of contrast.

A broad-scale assessment of visual sensitivity, based on the physical characteristics of the study area, economic activities and land use that predominates, determined that the area would have a low visual sensitivity. An important factor contributing to the visual sensitivity of an area is the presence, or absence of visual receptors that may value the aesthetic quality of the landscape and depend on it to produce revenue and create jobs. No formal protected areas, leisure-based tourism activities or sensitive receptor locations were identified in the study area, thus confirming the low level of visual sensitivity.

The desktop assessment did however identify multiple farmsteads and residences within the study area that could be considered to be receptors, although not all of them would be sensitive to the proposed development. These farmsteads are however regarded as potentially sensitive visual receptors as elements of the proposed development could potentially alter natural or semi-natural vistas experienced from these locations. At this stage however, local sentiments towards the proposed development are not known.

A total of fourteen (14) receptors were identified within 5 kms of the Mukondeleli EGI combined assessment corridor, three (3) of which are outside the viewshed for the EGI. None of the remaining receptors are considered sensitive. Of the remaining eleven (11) potentially sensitive receptor locations, six (6) are located within the Mukondeleli WEF project area and it has been assumed that the relevant land-owners are involved in the project. As such these land-owners are not expected to perceive the proposed development in a negative light.

None of the potentially sensitive receptors are expected to experience high levels of visual impact. Eight (8) of the receptor locations are expected to experience moderate levels of impact as a result of the EGI development, while the remaining three (3) would only experience low levels of visual impact.

Although the R546 Main Road could be considered a potentially sensitive receptor road, the likely visual impacts of the proposed development on motorists utilising this route would be reduced by the level of transformation and landscape degradation visible from the road and also by the presence of high voltage powerlines adjacent to the road. Visual impacts affecting the R546 are rated therefore rated as LOW

A preliminary assessment of overall impacts revealed that impacts (post mitigation) associated with the proposed Mukondeleli EGI are of LOW significance during construction, operation and decommissioning phases, with a number of mitigation measures available.

Considering the presence of existing mining and industrial activity and proposals for other renewable energy facilities in the broader area, the introduction of new EGI in the area will result in further change in the visual character of the area and alteration of the inherent sense of place, extending an increasingly industrial character into the broader area, and resulting in significant cumulative impacts. It is however anticipated that these impacts could be mitigated to acceptable levels with the implementation of the recommended mitigation measures. In light of this, cumulative impacts have been rated as MODERATE.

9.2.6 HERITAGE ASSESSMENT

There is one archaeological site that is known to occur in the centre of the proposed corridor in its southern section. However, because of the corridor approach which allows for plenty of space to shift the powerline within the corridor, it is expected that the site can be easily avoided. Should other environmental sensitivities dictate that the powerline neds to pass over the ruin then this is acceptable so long as the service track passes around it and the site is well protected during all phase of the development. This will need to be determined during finalisation of the EMPr but, at this point, it is assumed that the site can be avoided and protected. Areas further north are all either ploughed and planted, heavily disturbed, or under dense vegetation (including wetlands). Heritage resources are not expected to occur in any of these areas north of 26°36''24""S.

There are thus no significant concerns for this project from a heritage point of view. Furthermore, it is noted that both alternatives are acceptable and equal in impact, although Alternative 1 is marginally preferred simply because its Switching Substation is located further from the public road.

9.2.7 SOCIAL ASSESSMENT

The benefits associated with the proposed Mukondeleli WEF which include the use of renewable energy to produce green hydrogen and ammonia are dependent upon being able to connect the Mukondeleli WEF to the Secunda facility via the establishment of grid connection infrastructure.

The findings of the SIA indicate that the significance of the potential negative social impacts for both the construction and operational phase of the proposed 132 kV Mukondeleli overhead power line, substation and associated infrastructure are Low Negative with mitigation. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented. The establishment of proposed 132 kV Mukondeleli overhead power line and associated infrastructure, including the BESS, is therefore supported by the findings of the SIA.

9.2.8 RISK ASSESSMENT

This Risk Assessment has found that with suitable preventative and mitigative measures in place, none of the identified potential risks are excessively high, i.e., from a Safety, Health and Environment (SHE) perspective no fatal flaws were found with either type of technology for the BESS installation at the proposed Mukondeleli WEF near Secunda, nor for the BESS installation within the Sasol Secunda Industrial Complex.

— At a large facility, without installation of the state-of-the art battery technology that includes protective features, there can be significant risks to employees and first responders. The latest battery designs include many preventative and mitigative measures to reduce these risks to tolerable levels. (Refer to tables in section 4 under preventative and mitigative measures). State-of-the-art technology should be used, i.e., not old technology that may have been prone to fire and explosion risks.
— The design should be subject to a full Hazard and Operability Study (HAZOP) prior to commencement of procurement. A HAZOP is a detailed technical systematic study that looks at the intricacies of the design, the control system, the emergency system etc. and how these may fail under abnormal operating conditions. Additional safeguards may be suggested by the team doing the study.

LITHIUM SOLID STATE CONTAINERIZED BATTERIES

— With lithium solid-state batteries, the most significant hazard with battery units is the possibility of thermal runaway and the generation of toxic and flammable gases. There have been numerous such incidents around the world with batteries at all scales and modern technology providers include many preventative and mitigative features in their designs. This type of event also generates heat which may possibly propagate the thermal runaway event to neighbouring batteries if suitable state of the art technology is not employed.

- The flammable gases generated may ignite leading to a fire which accelerates the runaway process and may spread the fire to other parts of the BESS or other equipment located near-by.
- If the flammable gases accumulate within the container before they ignite, they may eventually ignite with explosive force. This type of event is unusual but has happened with an older technology container installed at McMicken in the USA in 2019.
- Due to a variety of causes, thermal runaway could happen at any point during transport to the facility, during construction or operation / maintenance at the facility or during decommissioning and safe making for disposal.
- Due to the containerized approach as well as the usual good practice of separation between containers, which should be applied on this project, and therefore the likely restriction of events to one container at a time, the main risks are close to the containers i.e., to transport drivers, employees at the facilities and first responders to incidents.
- In terms of a worst conceivable case container fires, the significant impact zone is likely to be limited to within 10m of the container and mild impacts to 20m. Based on the current proposed layouts, impacts at the closest isolated farmhouses or kennel facilities are not expected.
- In terms of a worst conceivable case explosion, the significant impact zone is likely to be limited to with 10m of the container and minor impacts such as debris within 50m. Based on the current proposed layouts, impacts at the closest isolated farmhouses or kennel facilities are not expected.
- In terms of a worst reasonably conceivable toxic smoke scenario, provided the units are placed suitably far apart to prevent propagation from one unit to another and large external fires are prevented, the amount of material burning should be limited to one container at any one time. In this case, beyond the immediate vicinity of the fire, the concentrations of harmful gases within the smoke should be low.
- For the BESS within the Sasol Secunda Industrial Complex, it is located in a low occupancy area. With the exception of the South Gate where there is a large office bock, most of the occupied facilities within 500m are industrial facilities with few permanent employees, e.g. West Steam Station Cooling Towers. It should also be noted that there are numerous flammable and toxic gas risks already posed by the existing chemical plants within the Sasol facility. The risks posed by the BESS will be low compared to the existing risks.

VANADIUM REDOX FLOW BATTERY INSTALLATIONS

- The most significant hazard with VRF battery units is the possibility of spills of corrosive and environmentally toxic electrolyte. Many preventative and mitigative features will be included in the design and operation, e.g., full secondary containment, level control on tanks, leak detection on equipment etc. (Refer to tables in section 4 under preventative and mitigative measures).
- VRF batteries do not present significant fire and electrical arcing hazards provided they are correctly designed, operated, maintained and managed. Suitable Battery Management System (BMS), safety procedures, operating instructions, maintenance procedures, trips, alarms and interlocks should be in place. (Refer to tables in section 4 under preventative and mitigative measures).

TECHNOLOGY AND LOCATION OF BESS FACILITIES

- From a safety and health point of view, the above Risk Assessment shows that risks posed by VRFB systems may be slightly lower than those of SSL facilities, particularly with respect to fire and explosion risks. From an environmental spill and pollution point of view the VRFB systems present higher short-term risks than the SSL systems. However, the above conclusions may be due to the fact that the VRFB technology is not as mature as SSL technology and therefore there is not as much operating experience and accident information available for the VRFB. Overall, from and SHE RA points of view, there is no specific preference for a type of technology.
- From a SHE risk assessment point of view, where there is a choice of location that is further from public roads, water courses, isolated farmhouses or other occupied facilities, this would be preferred. VRFB hazards are mostly related to possible loss of containment of electrolyte and SSL batteries to fires producing toxic smoke and fire fighting which may result in contaminated of firewater runoff. One would not want these liquids to enter water courses nor the smoke to pass close to houses / public traffic.

— For the BESS within the Sasol complex there is no specific preference, although at this location it may be easier to contain liquid spills from redox batteries than deal with toxic smoke from solid state batteries.

9.3 IMPACT SUMMARY

A summary of the identified impacts and corresponding significance ratings for the proposed powerline is provided in **Table 9-2** below.

Table 9-2: Impact Summary

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
Air Quality	Generation of Dust and PM	Construction	**Moderate**	(-)	**Low**	(-)
Noise	Noise Emissions	Construction	**Low**	(-)	**Low**	(-)
Soils, Land Capability and Agricultural Potential	Agricultural Production Potential	Construction	**Very Low**	(-)	**Very Low**	(-)
Soil Erosion & Contamination	Soil Erosion	Construction	**Moderate**	(-)	**Low**	(-)
	Soil Contamination	Construction	**Moderate**	(-)	**Low**	(-)
	Soil Contamination	Operation	**Low**	(-)	**Low**	(-)
Groundwater	Deterioration of Groundwater Quality	Construction	**Moderate**	(-)	**Low**	(-)
Aquatic	Changes in Water Flow Regime	Construction	**Moderate**	(-)	**Low**	(-)
	Changes In Sediment Entering And Exiting The System	Construction	**Moderate**	(-)	**Low**	(-)
	Introduction and spread of alien vegetation	Construction	**Moderate**	(-)	**Low**	(-)
	loss and disturbance of watercourse habitat and fringe vegetation	Construction	**Moderate**	(-)	**Low**	(-)
	Changes in water quality due to pollution	Construction	**Moderate**	(-)	**Low**	(-)
	Loss of Aquatic Biota	Construction	**Moderate**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Changes in Water Flow Regime	Operation	**Moderate**	(-)	**Low**	(-)
	Changes in sediment entering and exiting the system	Operation	**Moderate**	(-)	**Low**	(-)
	Introduction and spread of alien vegetation	Operation	**Moderate**	(-)	**Low**	(-)
	loss and disturbance of watercourse habitat and fringe vegetation	Operation	**Moderate**	(-)	**Low**	(-)
	Changes in water quality due to pollution	Operation	**Moderate**	(-)	**Low**	(-)
	Loss of Aquatic Biota	Operation	**Moderate**	(-)	**Low**	(-)
Biodiversity	Clearing Natural Vegetation	Construction	**Moderate**	(-)	**Low**	(-)
	The Loss Of Threatened, Protected & Endemic Plant Species	Construction	**Moderate**	(-)	**Low**	(-)
	Loss Of Faunal Habitat	Construction	**Moderate**	(-)	**Low**	(-)
	Direct Faunal Mortalities Due To Construction And Increased Traffic	Construction	**Moderate**	(-)	**Low**	(-)
	Increased Dust Deposition	Construction	**Moderate**	(-)	**Low**	(-)
	Increased Human Activity, Noise And Light Levels	Construction	**Moderate**	(-)	**Low**	(-)
	Establishment Of Alien Vegetation	Construction	**Moderate**	(-)	**Low**	(-)
	Establishment Of Alien Vegetation	Operation	**Low**	(-)	**Very Low**	(-)
	Faunal Mortalities	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Increased Dust Deposition	Decommissioning	**Low**	(-)	**Very Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Establishment Of Alien Vegetation	Decommissioning	**Low**	(-)	**Very Low**	(-)
Avifauna	Displacement due to disturbance associated with the construction	Construction	**Moderate**	(-)	**Low**	(-)
	Displacement due to habitat transformation associated with the construction	Construction	**Moderate**	(-)	**Low**	(-)
	Mortality of priority species due to collisions	Operation	**High**	(-)	**Low**	(-)
	Electrocution of priority species on the on-site substation infrastructure	Operation	**High**	(-)	**Very Low**	(-)
	Displacement of priority species due to disturbance associated with decommissioning of the on-site substation and 132kV overhead power line	Decommissioning	**Moderate**	(-)	**Low**	(-)
Visual	Potential visual impact of construction activities on sensitive visual receptors in close proximity to the proposed grid connection infrastructure	Construction	**Low**	(-)	**Low**	(-)
	Potential visual impact on sensitive visual receptors located during the operational phase	Operation	**Low**	(-)	**Low**	(-)
	Potential visual impact on sensitive visual receptors located during the decommissioning phase	Decommissioning	**Low**	(-)	**Low**	(-)
Heritage	Impacts to Archaeological resources	Construction	**High**	(-)	**Low**	(-)
	Impacts to Graves	Construction	**Moderate**	(-)	**Very Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Impacts to the Cultural Landscape	Construction	**Moderate**	(-)	**Moderate**	(-)
	Impacts to the Cultural Landscape	Operation	**Moderate**	(-)	**Moderate**	(-)
	Impacts to the Cultural Landscape	Decommissioning	**Moderate**	(-)	**Moderate**	(-)
Palaeontology	Impacts on palaeontological resources	Construction	**Very Low**	(-)	**Very Low**	(-)
Socio-economic	Creation of employment and business opportunities during the construction phase	Construction	**Low**	(+)	**Moderate**	(+)
	Potential impacts of Construction Workers On Local Communities	Construction	**Low**	(-)	**Low**	(-)
	Potential risk to safety, livestock and damage to farm infrastructure associated with the presence of construction workers on site	Construction	**Moderate**	(-)	**Low**	(-)
	Potential noise, dust and safety impacts associated with movement of construction related activities and movement of traffic to and from the site	Construction	**Low**	(-)	**Low**	(-)
	Potential impact of increased risk of veld fire	Construction	**Moderate**	(-)	**Low**	(-)
	Potential impacts associated with the loss of farm land	Construction	**Moderate**	(-)	**Low**	(-)
	Provide Energy Infrastructure To Support The Use Of Renewable Energy To Produce Green Hydrogen And Ammonia	Operation	**Moderate**	(-)	**Moderate**	(+)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Creation of employment, skills development and business opportunities associated with the operational phase	Operation	**Low**	(+)	**Moderate**	(+)
	Generate income for affected landowners	Operation	**Low**	(+)	**Moderate**	(+)
	The generation of additional income represents a significant benefit for the local affected farmer(s) and reduces the risks to their livelihoods posed by droughts and fluctuating market prices for sheep and farming inputs, such as feed etc.	Operation	**Low**	(+)	**Moderate**	(+)
	Creation Of Employment And Business Opportunities	Operation	**Low**	(+)	**Low**	(+)
	Generate Income For Affected Landowners	Operation	**Low**	(+)	**Moderate**	(+)
	Visual Impact And Impact On Sense Of Place	Operation	**Moderate**	(-)	**Low**	(-)
	Impact On Farming Operations During Maintenance	Operation	**Moderate**	(-)	**Low**	(-)
Safety, Health and Environmental Risk	Human health - chronic exposure to toxic chemical or biological agents for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human health - exposure to noise for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human health - exposure to temperature extremes and/or humidity for SSL BESS	Construction	**Low**	(-)	**Very Low**	(-)
	Human health - exposure to psychological stress for SSL BESS	Construction	**Low**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Human health - exposure to ergonomic stress for SSL BESS	Construction	**Low**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to explosion over pressures for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to violent release of kinetic or potential energy for SSL BESS	Construction	**High**	(-)	**Low**	(-)
	Human and equipment safety - exposure to electromagnetic waves for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Environment - emissions to air for SSL BESS	Construction	**Low**	(-)	**Very Low**	(-)
	Environment - emissions to water for SSL BESS	Construction	**Low**	(-)	**Low**	(-)
	Environment - emissions to earth for SSL BESS	Construction	**Low**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Environment - waste of resources e.g. water, power etc for SSL BESS	Construction	**Low**	(-)	**Very Low**	(-)
	Public – aesthetics for SSL BESS	Construction	**Low**	(-)	**Low**	(-)
	Investors – financial for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Employees and investors – security for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Emergencies for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Investors – legal for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human health - chronic exposure to toxic chemical or biological agents for VRF BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human health - exposure to noise for VRF BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human health - exposure to temperature extremes and/or humidity for VRF BESS	Construction	**Low**	(-)	**Very Low**	(-)
	Human health - exposure to psychological stress for VRF BESS	Construction	**Low**	(-)	**Low**	(-)
	Human health - exposure to ergonomic stress for VRF BESS	Construction	**Low**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for VRF BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to explosion over pressures for VRF BESS	Construction	**Very Lowe**	(-)	**Very Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Human and equipment safety - exposure to acute toxic chemical and biological agents for VRF BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to violent release of kinetic or potential energy for VRF BESS	Construction	**High**	(-)	**Low**	(-)
	Human and equipment safety - exposure to electromagnetic waves for VRF BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Environment - emissions to air for VRF BESS	Construction	**Low**	(-)	**Very Low**	(-)
	Environment - emissions to water for VRF BESS	Construction	**Low**	(-)	**Low**	(-)
	Environment - emissions to earth for VRF BESS	Construction	**Low**	(-)	**Low**	(-)
	Environment - waste of resources e.g. water, power etc for VRF BESS	Construction	**Low**	(-)	**Very Low**	(-)
	Public – aesthetics for VRF BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Investors – financial for VRF BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Employees and investors – security for VRF BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Emergencies for VRF BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Investors – legal for VRF BESS	Construction	**Moderate**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Human health - chronic exposure to toxic chemical or biological agents for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human health - chronic exposure to toxic chemical or biological agents for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human health - exposure to noise for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human health - exposure to temperature extremes and/or humidity for SSL BESS	Operational	**Low**	(-)	**Very Low**	(-)
	Human health - exposure to psychological stress for SSL BESS	Operational	**Low**	(-)	**Very Low**	(-)
	Human health - exposure to ergonomic stress for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to explosion over pressures for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS	Operational	**Low**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to violent release of kinetic or potential energy for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to electromagnetic waves for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Environment - emissions to air for SSL BESS	Operational	**Low**	(-)	**Very Low**	(-)
	Environment - emissions to water for SSL BESS	Operational	**Low**	(-)	**Low**	(-)
	Environment - emissions to earth for SSL BESS	Operational	**Low**	(-)	**Very Low**	(-)
	Environment - waste of resources e.g. water, power etc for SSL BESS	Operational	**Low**	(-)	**Very Low**	(-)
	Public – aesthetics for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Investors – financial for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Employees and investors – security for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Employees and investors – security for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Emergencies for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Investors – legal for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	**STATUS**	**SIGNIFICANCE**	**STATUS**
	Human health - chronic exposure to toxic chemical or biological agents for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human health - chronic exposure to toxic chemical or biological agents for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human health - exposure to noise for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human health - exposure to temperature extremes and/or humidity for VRF BESS	Operational	**Low**	(-)	**Very Low**	(-)
	Human health - exposure to psychological stress for VRF BESS	Operational	**Low**	(-)	**Very Low**	(-)
	Human health - exposure to ergonomic stress for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to explosion over pressures for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to acute toxic chemical and biological agents for VRF BESS	Operational	**Low**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Human and equipment safety - exposure to acute toxic chemical and biological agents for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to violent release of kinetic or potential energy for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to electromagnetic waves for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Environment - emissions to air for VRF BESS	Operational	**Low**	(-)	**Very Low**	(-)
	Environment - emissions to water for VRF BESS	Operational	**Low**	(-)	**Low**	(-)
	Environment - emissions to earth for VRF BESS	Operational	**Low**	(-)	**Very Low**	(-)
	Environment - waste of resources e.g. water, power etc for VRF BESS	Operational	**Low**	(-)	**Very Low**	(-)
	Public – aesthetics for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Investors – financial for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Employees and investors – security for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Emergencies for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Investors – legal for VRF BESS	Operational	**Moderate**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Human health - chronic exposure to toxic chemical or biological agents for both BESS types	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Human health - exposure to noise for both BESS types	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Human health - exposure to temperature extremes and/or humidity for both BESS types	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Human health - exposure to psychological stress for both BESS types	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Human health - exposure to ergonomic stress for both BESS types	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Human and equipment safety - exposure to fire radiation for both BESS types	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Human and equipment safety - exposure to explosion over pressures for both BESS types	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Human and equipment safety - exposure to acute toxic chemical and biological agents for both BESS types	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Human and equipment safety - exposure to violent release of kinetic or potential energy for SSL BESS	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Human and equipment safety - exposure to electromagnetic waves for SSL BESS	Decommissioning	**Very Low**	(-)	**Very Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Environment - emissions to air for SSL BESS	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Environment - emissions to water for SSL BESS	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Environment - emissions to earth for SSL BESS	Decommissioning	**Moderate**	(-)	**Low**	(-)
	Environment - waste of resources e.g. water, power etc for SSL BESS	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Public – aesthetics for SSL BESS	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Investors – financial for SSL BESS	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Employees and investors – security for SSL BESS	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Emergencies for SSL BESS	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Investors – legal for SSL BESS	Decommissioning	**Moderate**	(-)	**Low**	(-)

9.4 ALTERNATIVES ASSESSMENT

Table 9.3 outlines the alternative preferences resulting from the various specialist studies.

Table 9.3: Specialist Alternative Preferences

SPECIALIST STUDY	COMMENT	PREFERENCE
Agriculture and Soils	Because of the negligible agricultural impact, there is no material difference between the agricultural impacts of any substation alternative or OHPL route alternatives, alternative layouts within the corridor, or any technology alternatives. All possible alternatives are considered acceptable in terms of agricultural impact.	***Powerline:*** — No preference ***Substations:*** — No preference
Freshwater	Two potential route options as well as two IPP portion substation Alternatives in the south were investigated as well as one Substation in the north. The two routes follow the same route from the northern substation predominantly adjacent to Sasol access roads in a southern direction were the routes diverge to the two alternative IPP	***Powerline:*** — No Preference ***Substation:***

SPECIALIST STUDY	COMMENT	PREFERENCE
	portions. Surface water from both the alternative IPP portions (Substations) have increased significantly and are now wetter compared to images circa 1955. This indicates large impacts from the adjacent Sasol complex and other sources. Both substation options are located on areas not previously used for agriculture, however Substation Option two is located directly adjacent to an existing road and development here will have less impact compared to Substation Option 1 and is therefore suggested. The route options are similar and only differ at the end points near the proposed substations and Route Option 2 is thus the preferred option. However, due to both being in close proximity to wetlands and within the 500 m DWS regulated areas, the options should be weighed against the other specialist findings.	— Option 1 — Sasol Site
Biodiversity	**Onsite Substation:** The site location for the onsite substation is acceptable in terms of our sensitivity findings and falls in a habitat with low sensitivity. However, the site falls in an area demarcated as CBA1 and therefore should be re-located to a more acceptable location. The substation site also falls in an area demarcated as seep. The presumable alternative on-site substation also falls in a CBA1 and seep and should be relocated to a more acceptable location. **OHPL**: Both options cover some CBAs, ESAs and Wetlands. Option 1 is the shortest option **Sasol step-down substations & BESS**: Both sites are located in totally degraded areas.	***Powerline:*** — Option 1 ***Substation:*** — Option 1 — Sasol Site
Avifauna	There is no material difference between the avifaunal impacts of any substation alternative or OHPL route alternatives	***Powerline:*** — No preference ***Substation:*** — No preference
Visual	No fatal flaws were identified for either of the substation site alternatives or any of the proposed powerline corridor alternatives and all alternatives were found to be favourable	***Powerline:*** — No preference ***Substation:*** — No preference
Heritage	Given the corridor approach being taken for this project, it is assumed that the one heritage resource known to occur in the corridor can be avoided by the proposed powerline and its associated service track. It is thus the opinion of the heritage specialist that the proposed powerline, using either alternative, can be authorised in full.	***Powerline:*** — No preference ***Substation:*** — No preference
Socio-economic	Based on the findings of the SIA, Alternative 1 is the preferred Option for the OHPL. There is no preference with regards to the substation locations	***Powerline:*** — Option 1 ***Substation:*** — No Preference
Risk	There are no fatal flaws associated with the proposed BESS installation for either technology type	***BESS Technology*** — No preference

Based on the table above, it can be concluded that the OHPL Alignment Option 1, the onsite substation Option 1 and the sasol substation can be considered preferred.

The preferred route and proposed onsite substations are illustrated in **Figure 9-13** and the co-ordinates are included in **Table 9.4**.

Table 9.4: Co-ordinates of the preferred route and associated infrastructure

POINT	CO-ORDINATES	
OHPL Option 1 (Preferred)		
PL1	26°36'59.30"S	29°11'19.65"E
PL2	26°36'59.45"S	29°11'17.47"E
PL3	26°36'53.07"S	29°11'13.45"E
PL4	26°36'55.29"S	29°10'59.40"E
PL5	26°36'48.48"S	29°10'55.54"E
PL6	26°35'59.63"S	29°10'41.18"E
PL7	26°35'7.14"S	29° 9'51.97"E
PL8	26°34'53.03"S	29° 9'56.25"E
PL9	26°34'45.15"S	29° 9'52.44"E
PL10	26°34'41.96"S	29° 9'30.17"E
PL11	26°34'17.65"S	29° 9'25.50"E
PL12	26°33'53.46"S	29° 9'29.04"E
PL13	26°33'50.44"S	29° 9'40.92"E
Mukondeleli Substation - Option 1 (Preferred)		
		
1A	26°36'57.14"S	29°11'19.43"E
1B	26°36'57.25"S	29°11'24.54"E
1C	26°37'1.97"S	29°11'24.72"E
1D	26°37'1.96"S	29°11'19.81"E
Sasol Substation (including BESS)		

POINT	CO-ORDINATES	
		
SA	26°33'45.12"S	29° 9'38.16"E
SB	26°33'46.28"S	29° 9'47.44"E
SC	26°33'51.36"S	29° 9'46.68"E
SD	26°33'50.22"S	29° 9'37.77"E

Figure 9-13: Preferred Mukondeleli OHPL Alignment

9.5 RECOMMENDATIONS

The following key aspects are recommended to be included as conditions of authorisation:

- The layouts submitted in the Final BAR are not finalised. The final layouts are to be submitted to the MDARDLEA for approval prior to construction;
- The site-specific EMPr submitted in the Final BAR is to be approved.. The EMPr is to be updated to include the final layout map once finalised and approved by MDARDLEA.
- <u>A 200m buffer was assessment around the substations and a 250m wide corridor was assessment along the alignment, to allow for micro-siting;</u>
- The EMPr and BAR mitigation measures must be adhered to;
- Recommendations for the layout as provided by the relevant specialists must be implemented as far as possible;
- The final EMPr must form part of all contractual documents with contractors during construction and operational phases of the project. Furthermore, a dedicated Environmental Control Officer (ECO) must be appointed to ensure compliance to all EA conditions and EMPr commitments throughout the construction phase;
- Appropriate permits in terms of the Mpumalanga Natura Conservation Act (No. 10 of 1998) must be obtained before commencement; and
- Where required, water use authorisation under NWA is to be obtained from the DWS prior to construction.

The following recommendations are made in respect of the proposed Project:

- It is recommended that the footprint of each pylon be assessed with a walk down when available to give input into placing where possible outside of watercourses and watercourse buffer zones.
- A flora and fauna search and rescue should be undertaken before any vegetation clearing
- The habitats that are designated as having an elevated sensitivity should be avoided as far as is technically possible.
- It is recommended that monitoring in terms of wetland PES as well as biomonitoring be conducted to consider the cumulative impacts of the proposed Vhuvhili SEF, Mukondeleli WEF (subject to separate applications) as well as the gridline solution. Monitoring should be conducted in both the construction and operational phases of the project.
- It is imperative that an AIS plant management plan be developed, prior to the construction phase. Clearing and/treatment of these species occurs prior to any construction activities which will curb the spread of AIS plants due to the disturbance events caused by construction.
- <u>The development must not impact on any sensitive features on site including their recommended buffer zones.</u>
- <u>Development within a 50 m buffer of wetlands or waterbodies must be avoided along with the rechannelling of any waterbodies.</u>
- <u>In the event that bird mortalities occur after the mitigation measures has been applied the developer should consider to provide a compensation plan (Biodiversity offset), by contributing to student research proposals and funds for the Bird of Prey rehabilitation centrum near Dullstroom.</u>
- Implement a monitoring program for the early detection of alien invasive plant species.
- Ensure that the placing of infrastructure takes the sensitivity mapping of the ecological assessment into account to avoid and reduce impacts on species and habitats of conservation concern.
- Demarcate all infrastructure sites clearly to avoid unnecessary clearance of the vegetation.
- Avoid or minimise impacts that could potentially affect animal behaviour.
- Trenches should not be left open for long periods of time. Trenches should regularly be inspected for the presence of trapped animals.
- Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns.
- Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the site.

- Speed limits should be strictly adhered to.
- Dust control measures should be implemented.
- Conduct a pre-construction inspection to identify Red List species that may be breeding within the project footprint to ensure that the impacts to breeding species (if any) are adequately managed.
- The authorised alignment must be inspected by an avifaunal specialist by means of a “walk-through” inspection i.e., through a combination of satellite imagery supplemented with in situ inspections by vehicle and where necessary, on foot, once the pole positions have been finalised. The objective would be to demarcate the sections of the powerline that need to be fitted with Bird Flight Diverters.
- Once the relevant spans have been identified, Bird Flight Diverters must be fitted according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines). These devices must be installed as soon as the conductors are strung;
- The Chance Fossil Finds Procedure must be implemented throughout the construction phase of the development;
- If possible, the powerline must be located in such a way as to avoid the site at MD007. Should this not be possible then the site must be spanned with no pylons placed within 50 m of the walling and the service track must be routed around the ruin with a buffer of at least 30 m;
- The final Switching Substation footprint and powerline alignment south of 26°36’24”S must be surveyed prior to construction to determine whether any further sites are present (arable lands need not be covered due to their low sensitivity);
- No stones may be removed from any archaeological site;
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
- The section of the alignment that is shared by Alternative 1 and 2 should be realigned to the east so that it follows the cadastral boundary with Bosjesspruit 291/9.[13]
- There are numerous different battery technologies, but using one consistent battery technology system for the BESS installations associated with all the developments in the Secunda area associated with the Mukondeleli Project would allow for ease of training, maintenance, emergency response and could significantly reduce risks.
- Where reasonably practicable, state-of-the-art battery technology should be used with all the necessary protective features e.g., draining of cells during shutdown and standby-mode, full BMS with deviation monitoring and trips, leak detection systems.
- The overall design should be subject to a full Hazop prior to finalization of the design.
- Prior to bringing any solid-state battery containers into the country, the contractor should ensure that:
  - An Emergency Response Plan is in place that would be applicable for the full route from the ship to the site. This plan would include details of the most appropriate emergency response to fires both while the units are in transit and once they are installed and operating.
  - An End-of-Life plan is in place for the handling, repurposing or disposal of dysfunctional, severely damaged batteries, modules and containers.
- The site layout and spacing between lithium solid-state containers should be such that it mitigates the risk of a fire or explosion event spreading from one container to another
- All proposed mitigation measures includes in this BA Report and in the site specific and generic EMPRs (**Appendix G**) must be implemented in order to reduce possible impacts to an acceptable level.

[13] As indicated above, ENERTRAG South Africa has met with the affected landowners to address the issues raised. The alignment can be accommodated within the 200m corridor that is being assessed.

9.6 CONCLUSION AND AUTHORISATION OPINION

The overall objective of the BA is to provide sufficient information to enable informed decision-making by the authorities. This was undertaken through consideration of the proposed Project components, identification of the aspects and sources of potential impacts and subsequent provision of mitigation measures.

It is the opinion of WSP that the information contained in this document (read in conjunction the EMPr) is sufficient for MDARDLEA to make an informed decision for the environmental authorisation being applied for in respect of this Project.

Mitigation measures have been developed, where applicable, for the above aspects and are presented within the site specific and generic EMPRs (**Appendix G**). It is imperative that all impact mitigation recommendations contained in the EMPr, of which the environmental impact assessment took cognisance, are legally enforced.

Considering the findings of the respective studies, no fatal flaws were identified for the proposed Project. Should the avoidance and mitigation measures prescribed be implemented, the significance of the considered impacts for all negative aspects pertaining to the environmental aspects is expected to be low. It is thus the opinion of the EAP that the Project can proceed, and that all the prescribed mitigation measures and recommendations are considered by the issuing authority.

EA AUTHORISATION PERIOD

Appendix 1(3)(1)(q) of the NEMA EIA Regulations 2014, as amended requires "where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required, the date on which the activity will be concluded, and the post construction monitoring requirements finalised" must be included in the BA Report.

The EA is required for a period of 10 years from the date of issuance of the EA to the end of the construction period (including rehabilitation), when the proposed activities applied for are completed. This is a reasonable period as it allows Mukondeleli WEF to conduct its internal processes which can only begin after issuance of the EA, when the proposed route is confirmed.

10 WAY FORWARD

This report provides a description of the proposed Project and details the aspects associated with the construction and operation. The report also includes the methodology followed to undertake the BA process. A detailed description on the existing environment (biophysical as well as socio-economic) is provided based on findings from the specialist surveys and existing information. Stakeholder engagement undertaken from the onset of the assessment to date, has been conducted in a transparent and comprehensive manner. This report will be subjected to a public review period in line with NEMA EIA Regulations, 2014 as amended. Outcomes of all comments received from the public review period will be recorded and responded to in the Final BAR. Based on the environmental description, specialist surveys as well as the stakeholder engagement undertaken to date, a detailed impact assessment was undertaken and, where relevant, the necessary management measures have been recommended.

In summary, the BA process assessed both biophysical and socio-economic environments and identified appropriate management and mitigation measures. The biophysical impact assessment revealed that there are no moderate or major environmental fatal flaws and no significant negative impacts associated with the proposed Project should mitigation and management measures be implemented. In addition, it should be noted that there are positive (albeit limited) socio-economic impacts associated with the Project.

The draft BAR (this report) was made available for public review from **19 January 2023** and **20 February 2023**. All comments received have been incorporated in the Comments and Response Report (CRR) which are attached as **Appendix D** to this, the final BAR.

The final BAR will be submitted to the competent authorities. It is the opinion of WSP that the information contained in this document is sufficient for the MDARDLEA to make an informed decision for the EA being applied for in respect of this Project.

APPENDIX

A EAP CV

APPENDIX

B DECLARATION OF EAP

APPENDIX

C SPECIALIST DECLARATIONS

APPENDIX

D STAKEHOLDER ENGAGEMENT REPORT

APPENDIX

E A3 MAPS

APPENDIX

F SPECIALIST STUDIES

APPENDIX

F-1 AVIFAUNA

F-2 BIODIVERSITY

F-3 HERITAGE

F-4 PALAEONTOLOGY

F-5 SOCIO-ECONOMIC

F-6 *AQUATIC*

F-7 VISUAL

F-8 AGRICULTURE

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APPENDIX

F-10 DESKTOP GEOTECHNICAL

APPENDIX

G EMPR

APPENDIX

H SCREENING TOOL REPORT

APPENDIX

I PRE-APPLICATION MEETING APPLICATION